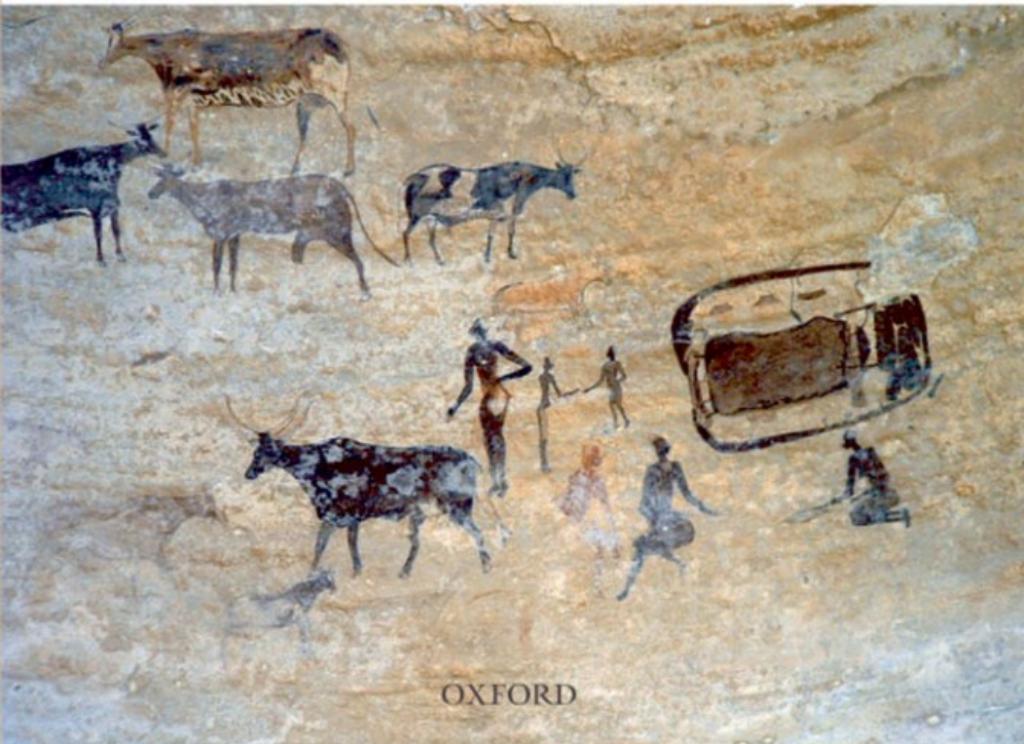




The Agricultural Revolution in Prehistory

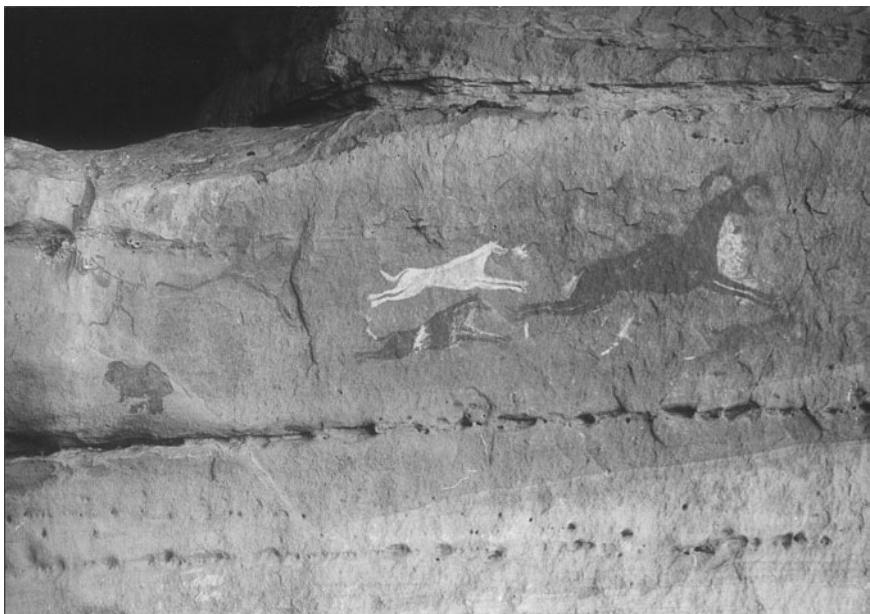
Why did Foragers become Farmers?

GRAEME BARKER



OXFORD

THE AGRICULTURAL REVOLUTION
IN PREHISTORY



Frontispiece: Prehistoric Saharan rock painting of goat-hunting (photograph: Graeme Barker).

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Preface and Acknowledgements

FROM the historical perspective of revolutions lasting a couple of centuries like the Agricultural and Industrial Revolutions, or a few decades like the Information Revolution today, the beginnings of farming in prehistory may seem an unlikely candidate for revolutionary status. The transition from foraging (hunting and gathering) to farming took thousands of years in most regions of the world; indeed, in some respects its roots are as old as our species. Yet in its impact on who we are and how we live today it was indeed a revolution, in many respects the most profound in human history. Ten thousand years ago there were few if any societies which can properly be described as agricultural. Five thousand years ago large numbers of the world's population were farmers, using a wide variety of crops and animals in different combinations in different regions. Yet numerous societies in Africa, Asia, Australia, and the Americas were still living by various combinations of hunting, fishing, and gathering at the time of European colonial contact. A very few societies still live largely by these means today, though the vast majority of the world's population is fed by farming. So, if producing food has had so many advantages for the competitive success of our species, and if the first farming began many thousands of years ago, why did some people become farmers so quickly, but others take so long? Why did foraging societies decide—some sooner, some later, some much later—that the advantages of food production outweighed the options available to them as foragers?

One of the problems with the debates about agricultural origins and dispersals is that they have mostly been regionally specific, whereas probably the most intriguing aspect of the transition to farming is that it was a global process. To attempt to understand that process therefore demands a regionally comparative approach. The project also has to embrace a daunting array of evidence, both archaeological and non-archaeological. For every region we need to understand changes in climate and environment, the nature of the plant and animal resources available, and how they were exploited by people on either side of the presumed transitional phase(s) from foraging to farming. But if we are to understand why prehistoric foragers became farmers, we also have to try to imagine how they must have viewed their world and the challenges and choices available to them. To answer questions of how and why, therefore, as well as what, where, and when, we need to draw on anthropology and social archaeology as much as on archaeological science and

other disciplines. This book is an attempt, however foolhardy, to bring to bear such an holistic approach, at the global scale, on the problem of why foragers became farmers.

Chapter 1 sets the scene by discussing the development of ideas about the beginnings of farming, from Victorian speculations about a ladder of progress from barbarism to civilization to recent theorizing about the cognitive changes involved in foragers becoming farmers. Chapter 2 summarizes the principal characteristics of present-day forager societies in terms of their subsistence behaviour, social organization, demography, and world-views, and what we may be able to glean from that study about the nature of foraging societies in prehistory. Chapter 3 reviews the methodologies and sources of evidence available for investigating the transition from foraging to farming, and their strengths and weaknesses. The following six chapters then summarize the evidence that can be assembled from those methodologies for transitions from foraging to farming on a region by region basis. I begin with South-West Asia (the ‘Near East’) as the traditionally assumed ‘hearth of domestication’ (Chapter 4). Then, for reasons that will become clear, rather than as in many such studies moving next to a consideration of China and Central America as the two other assumed ‘early hearths’, I consider the processes of transition first in Central and South Asia (Chapter 5), then in East and South-East Asia (Chapter 6), then the Americas as a whole (Chapter 7), then throughout Africa (Chapter 8), and finally in Europe (Chapter 9). The principal features and wider implications of each regional story are summarized at the end of the respective chapter, and the themes and issues that I have discerned in those studies are then reviewed in my concluding chapter (Chapter 10).

My interest in why foragers became farmers was first aroused when, as a final-year undergraduate at Cambridge, I took an option course taught by Eric Higgs on the early history of agriculture (it was that or the Minoans and Mycenaeans, if I remember correctly!). Eric Higgs was the director of a British Academy-funded research project at Cambridge on the same topic (Chapter 1, pp. 29–30). After graduation I went on to take a Ph.D. under his supervision on the transition from foraging to farming in central Italy. Some years later I wrote a book on *Prehistoric Farming in Europe* (1985) that involved me in reflecting on the transition throughout Europe. In a peripatetic research career I have also conducted fieldwork beyond Europe, in Mozambique, Libya, Jordan, and most recently Sarawak (Borneo), much of which has had a concern with agricultural transitions.

In the 35 years or so I have been involved in archaeology, I have learned a huge amount about the beginnings of farming from discussions with an array of archaeologists and scholars in other disciplines, working in all the regions discussed in this book. The size of the bibliography is one indicator of the

debt I hold to that large and diverse community of researchers throughout the world whom it has been my privilege to know as scholars and, in very many cases, as colleagues and friends. It is invidious to pick out individuals, but I have learned a lot (I hope) in particular from Geoff Bailey, Huw Barton, Peter Bogucki, Robin Dennell, Clive Gamble, David Harris, Charles Higham, Ian Hodder, Martin Jones, Steve Mithen, Colin Renfrew, and Ezra Zubrow. The School of Archaeology and Ancient History of the University of Leicester provided me with a stimulating and supportive research environment during the main researching and writing of the text. I am especially grateful to my colleague there David Mattingly, who always asked me the most thought-provoking questions about my research and enthused me with its worth.

The primary research for the book, and much of the initial writing, was undertaken when I was a Research Fellow at the Netherlands Institute for Advanced Study in the Humanities and Social Sciences, in the spring of 1999. I owe NIAS an enormous debt of gratitude for the wonderful opportunity it gave me in terms of a stimulating multi-disciplinary research community and matchless research support, including the tireless help of Dinny Young, the NIAS librarian, and her staff. I am extremely grateful to the University of Leicester for giving me a term's research leave in 2003 to bring the project nearer to completion, and especially to Martin Stannard for agreeing to stand in as the Graduate Dean, making the research leave possible. I would like to thank the Oxford University Press anonymous readers for their invaluable comments and criticisms, and Emma Harvey, Charles Higham, and Dolores Piperno for their detailed comments on, respectively, Chapters 5, 6, and 7. I would also like to acknowledge the support of Laura Holborow at Leicester and Deborah Parr, Katie Boyle, and Xinyi Kiu at Cambridge in the task of seeking permissions for photographs and other images. I am especially grateful to Lucy Farr for her care, patience, and skill in preparing the numerous line drawings. Finally, I would like to acknowledge my greatest debt of gratitude, which is to my partner Annie, for her forbearance with this long-maturing project, as for everything else, and for her love and support.

G.B.

*Cambridge
September 2005*

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Contents

<i>List of Figures</i>	x
<i>List of Tables</i>	xv
<i>Abbreviations</i>	xvi
1. Approaches to the Origins of Agriculture	1
2. Understanding Foragers	42
3. Identifying Foragers and Farmers	73
4. The ‘Hearth of Domestication’? Transitions to Farming in South-West Asia	104
5. Central and South Asia: the Wheat/Rice Frontier	149
6. Rice and Forest Farming in East and South-East Asia	182
7. Weed, Tuber, and Maize Farming in the Americas	231
8. Africa: Afro-Asiatic Pastoralists and Bantu Farmers?	273
9. Transitions to Farming in Europe: <i>Ex Oriente Lux?</i>	325
10. The Agricultural Revolution in Prehistory: Why did Foragers become Farmers?	382
<i>References</i>	415
<i>Index</i>	527

List of Figures

1.1. (<i>above</i>) ‘Man in the Great Bear and Mammoth Epoch’ and (<i>below</i>) ‘The art of bread-making in the Stone Age’	7
1.2. Gordon Childe’s ‘Areas of Civilization about 2500 BC’	12
1.3. Centres of origin of major crops, as hypothesized by N. I. Vavilov	18
1.4. Major early farming sites in the ‘hilly flanks of the Fertile Crescent’ excavated in the 1950s and 1960s	19
1.5. ‘Pathways to agriculture’: changes in subsistence as reconstructed in the Deh Luran plain, Iran, and Tehuacán valley, Mexico	20
1.6. ‘Hearths of domestication’ in the New World as they appeared in the 1970s	23
1.7. The spread of farming and farmers from South-West Asia into Europe according to the first series of radiocarbon dates	25
1.8. Binford’s and Flannery’s ‘marginal zone’ hypothesis	28
1.9. ‘Domestication as a continuous process’	31
1.10. The ‘population pressure’ hypothesis for the origins of agriculture	33
1.11. Evolutionary sequence describing the development of farming and domestication from foraging	37
1.12. ‘Push’, ‘pull’, and ‘social’ models for the transition to agriculture	37
2.1. The distribution of forager societies today	43
2.2. Traditional hunting territories in the Canadian sub-Arctic	48
2.3. Binford’s model of forager and collector systems	49
2.4. The role of storage amongst hunter-gatherer societies	50
2.5. Modelling decision-making about diet breadth	51
2.6. Australian Aboriginal foragers digging for goanna in burnt woodland	61
2.7. Penan foragers in Sarawak, Borneo, making sago	64
2.8. Nunamiut hunting territories in northern Alaska	67
2.9. A prehistoric rock carving from Jiebmaluok’ta near Alta, Norway, showing reindeer inside and outside a fenced corral	69
3.1. An Australian Aboriginal forager using a digging stick to dig for yams	75
3.2. A shepherd encampment in Italy	78
3.3. Geomorphological fieldwork in the Wadi Faynan, Jordan	80
3.4. The Swiss Neolithic settlement of Thayngen Weier	82

3.5. Rice-husk in a human coprolite from Khok Phanom Di	83
3.6. Food-plant remains from prehistoric sites in Island South-East Asia	84
3.7. c.40,000-year-old starch grains of sago palm and yam from Niah Cave, Sarawak	85
3.8. The formation of the archaeological faunal sample	90
3.9. The areas of the skeleton most affected by the use of the saddle quern	94
3.10. Signs of health, disease, and nutrition in human bone material	95
3.11. Approximate locations of suggested domestication centres for sheep, cattle, pig, and water buffalo	97
3.12. Saharan rock art: engravings of domestic cattle and sheep from the Messak Settafet, south-west Libya	100
3.13. Schleicher's family tree model for the Indo-European languages	101
4.1. South-West Asia, showing principal regions and sites	105
4.2. Distributions of modern wild cereals	107
4.3. Plan of main area of excavation at Ohalo II, and hut reconstruction	112
4.4. Prehistoric grinding/pounding tools from the Levant	113
4.5. Late Glacial and early Holocene temperature fluctuations	117
4.6. Structures at Natufian 'Ain Mallaha	119
4.7. Natufian Abu Hureyra: gathering and hunting seasons	122
4.8. Stone kites on the Jordanian steppe	124
4.9. Natufian sculpted objects	127
4.10. PPNA Netiv Hagdud: plan of structures and a reconstruction of a hut	133
4.11. Abu Hureyra: Natufian and PPNB structures	138
4.12. The development of building architecture at Neolithic Beidha	142
4.13. PPNB residential architecture and mortuary practices	144
5.1. Central and South Asia, showing principal regions and sites	150
5.2. Plan of Jeitun	157
5.3. Mehrgarh: buildings of Period IB, fifth millennium BC	159
5.4. Changing frequencies of fauna at Mehrgarh	161
5.5. Size changes of cattle, sheep, and goats at Mehrgarh	163
5.6. Mesolithic rock art, India	166
5.7. Faunal remains from later Mesolithic sites in the central Ganga valley	169
5.8. Carbonized rice grain from Mahagara in the Belan Valley	170
5.9. Stamp seal from Mohenjo-daro of a Harappan zebu bull	173
5.10. Aligrama, Pakistan: a ploughed field dated to the second millennium BC	176
5.11. Carbonized plant remains from the Indian Southern Neolithic	177

5.12. Inferred seasonality of Southern Neolithic cultivation and foraging	178
6.1. East and South-East Asia, showing principal regions and sites	183
6.2. Vegetation types in China today and during the Holocene climatic optimum	184
6.3. Carbonized rice from Bashidang	192
6.4. Agricultural tools from early Neolithic sites in China	193
6.5. Hemudu: plan and photograph of remains of timber buildings	196
6.6. Artefacts from Hemudu	197
6.7. Plan of Yang-shao village at Jiangzhai	198
6.8. Major components of subsistence at Jomon Torihama	202
6.9. Plan of Middle Jomon settlement at Nishida	203
6.10. Plan of rice fields and canals at the Initial Yayoi site of Itatsuke	205
6.11. South-East Asia at the Last Glacial Maximum	206
6.12. The West Mouth of Niah Great Cave	208
6.13. c.30,000-year-old waisted axe from Kosipe, New Guinea	209
6.14. Hoabinhian artefacts	211
6.15. Rice grain inside a Khok Phanom Di vessel	215
6.16. A Neolithic burial from Ban Non Wat	216
6.17. Peter Bellwood's model for the expansion of Austronesian-speaking farmers	218
6.18. Swamp cultivation at Kuk, New Guinea: the chrono-stratigraphic sequence	219
6.19. Swamp cultivation at Kuk, New Guinea: taro(?) cultivation beds	220
6.20. A regional model of agricultural prehistory in the New Guinea Highlands	221
7.1. The Americas, showing principal regions and sites	232
7.2. Palaeoindian bison kill-sites on the North American plains	237
7.3. Late Pleistocene landscapes in Central and South America	240
7.4. Animals of the rainforest in Central and South America	241
7.5. Rind fragment of squash from Koster, Illinois, c.5000 bc	243
7.6. The domestication of indigenous crop plants in eastern North America, based on morphological changes	243
7.7. Scanning electron micrograph of a domesticated goosefoot (<i>Chenopodium berlandieri</i>) seed from Ash Cave, Ohio	244
7.8. Hohokam irrigation systems	249
7.9. Castrating a mature maguey plant	253
7.10. How maize is presumed to have evolved from teosinte	255

7.11. The likely domestication areas for various crop plants in Central and South America	256
7.12. Summary phytolith and charcoal profile from Lake La Yaguda, Panama	260
7.13. Early and late cultivars in South America	264
7.14. Carbon and nitrogen isotopic values for skeletons from Tunanmarca, Peru	270
8.1. Africa, showing principal regions and sites	274
8.2. The distribution of Africa's major language families	279
8.3. Plant domestication in Africa, on the basis of modern plant botany and geography	281
8.4. The domestication and early movements of sorghum	282
8.5. Mortality profiles for Barbary sheep killed at Haua Fteah	284
8.6. Wadi Kubaniya, Egypt: wild nut-grass (<i>Cyperus rotundus</i>) c.15,000 BC	286
8.7. Sorghum grain from Nabta Playa	290
8.8. The Tadrart Acacus mountains in south-west Libya	296
8.9. The Uan Afuda cave in the Tadrart Acacus	296
8.10. The Uan Afuda cave: fragments of baskets with seeds of <i>Urochlea/Brachiaria</i> still attached	298
8.11. Grooved stones found at pastoralist sites in the Sahara, used for traps or hobbles	301
8.12. Saharan rock art: engravings of giraffes and domestic cattle from the Messak Settafet, south-west Libya	303
8.13. Changes in the shape of skulls of prehistoric Nubians at the transition to farming	307
8.14. Dakhlet el Atrous, the largest of the Dhar Tichitt settlements	309
8.15. First-millennium BC banana phytolith from Nkang, Cameroon, compared with a modern specimen	313
8.16. Alternative models of how hunting and herding may have been combined at Prolonged Drift, Kenya	315
8.17. Kuper's Central Cattle Pattern	318
8.18. Detail of the main frieze at Snake Rock, Hungorob Ravine, Namibia	320
9.1. Europe, showing principal regions and sites mentioned in the text	326
9.2. The 'wave of advance' of Neolithic farmers across Europe according to Ammerman's and Cavalli-Sforza's interpretation of 14C dates in 1971	327
9.3. Engraved horse head from La Marche	330
9.4. The landscape transformations of the late Pleistocene and early Holocene in 'Doggerland', north-west Europe	333
9.5. The Iron Gates fishing village of Lepenski Vir	341

9.6. A model of Late Mesolithic resource scheduling and territoriality in eastern northern England	342
9.7. A Mesolithic burial from Vedbaek, Denmark	344
9.8. Similarities in the material culture of Early Neolithic tells in Greece and the Levant	347
9.9. Air photograph of Passo di Corvo Neolithic settlement, Italy	350
9.10. Forager–farmer interactions and transformations in the Balkans and middle Danube basin	354
9.11. Balkan Neolithic tell dwellings	355
9.12. The distribution of primary LBK (<i>Linearbandkeramik</i>) settlement in Europe	358
9.13. LBK (<i>Linearbandkeramik</i>) houses	359
9.14. The clustered distribution of LBK sites in the Merzbach valley, north-west Germany	362
9.15. Evidence for forager–farmer contacts on the north European plain and in southern Scandinavia in the fourth millennium BC	365
9.16. A model of changing relations between foragers and farmers in the Atlantic and Baltic regions	366
9.17. Neolithic houses in Britain	371
9.18. Early Neolithic landscapes in southern England	373
9.19. The Neolithic co-axial field systems at Céide, Behy Glenura, County Mayo	375
9.20. The Sweet Track, a Neolithic trackway in Somerset, south-west England	376
9.21. The elm decline in Europe	380
10.1. A relief carving from Kalabsha, Nubia, showing the taming of wild animals	394
10.2. Tamed red deer on Rhum, Scotland, and a red deer farm in Scotland	395
10.3. Global population estimates over the past 100,000 years	400
10.4. Eggs of the <i>Trichuris</i> intestinal parasite from Late Mesolithic sediments at Goldcliff, South Wales	401
10.5. Major axes of the continents	404
10.6. Mesolithic and Neolithic burials at Dragsholm, Denmark	408

List of Tables

1.1. Hodder Westropp's 'Tabulation of the Stages of Development of Man and Implements'	5
2.1. Energy return rates of Aché foragers in eastern Paraguay	52
2.2. General expectations of foragers' resource use of high- and low-ranked food items	53
2.3. Comparison of New Guinea farmer and Australian forager population densities	70
4.1. Plant foods available in South-West Asia before and after 15,000 bp	110
4.2. Ripening seasons of grains and fruits at Ohalo II	115
4.3. Percentages of unfused and fused gazelle metapodials at Nahal Oren	123
5.1. Some common crops in South Asian agriculture, and their assumed origins	152
5.2. Cultivated plants from Indus Valley sites of the third and second millennia bc	172
7.1. Probable regions where crops were domesticated in the tropical lowlands of Central and South America	257
7.2. Plant remains from some Formative sites in the tropical lowlands of South America	266
8.1. Faunal remains from early Holocene rock shelters in the Tadrart Acacus mountains, Libya	297
8.2. Domesticated plants reported from Early Iron Age sites in South Africa	317
9.1. The vegetational succession (and its climatic implications) in north-west Europe in the late Pleistocene and the Holocene	334
10.1. Some of the causes proposed for the transition from foraging to farming	383

Abbreviations

Specialist terms are explained at the first mention, but regularly occurring abbreviations and specialist terms include:

aDNA	ancient DNA
AMS	Accelerator Mass Spectrometry
C3 plants	temperate-climate plants
C4 plants	plants grown in high temperature and lots of sunshine
LGM	Last Glacial Maximum
mtDNA	mitochondrial DNA
PPNA	Pre-Pottery Neolithic A
PPNB	Pre-Pottery Neolithic B

1

Approaches to the Origins of Agriculture

INTRODUCTION

Humans have occupied our planet for several million years, but for almost all of that period they have lived as foragers, by various combinations of gathering, collecting, scavenging, fishing, and hunting. The first clear evidence for activities that can be recognized as farming is commonly identified by scholars as at about 12,000 years ago, at about the same time as global temperatures began to rise at the end of the Pleistocene (the ‘Ice Ages’) and the transition to the modern climatic era, the Holocene. Subsequently, a variety of agricultural systems based on cultivated plants and, in many areas, domesticated animals, has replaced hunting and gathering in almost every corner of the globe. Today, a relatively restricted range of crops and livestock, first domesticated several thousand years ago in different parts of the world, feeds almost all of the world’s population. A dozen crops make up over 80 per cent of the world’s annual tonnage of all crops: banana, barley, maize, manioc, potato, rice, sorghum, soybean, sugar beet, sugar cane, sweet potato, and wheat (Diamond, 1997: 132). Only five large (that is, over 100 pounds) domestic animals are globally important: cow, sheep, goat, pig, and horse.

The development of agriculture brought profound changes in the relationship between people and the natural world. Archaeologists have usually theorized that, with the invention of farming, people were able to settle down and increase the amount and reliability of their food supply, thus allowing the same land to support more people than by hunting and gathering, allowing our species to multiply throughout the world. The ability to produce food and other products from domesticated plants and animals surplus to immediate subsistence requirements also opened up new pathways to economic and social complexity: farming could mean new resources for barter, payment of tax or tribute, for sale in a market; it could mean food for non-food producers such as specialist craft-workers, priests, warriors, lords, and kings. Thus farming was the precondition for the development of the first great

urban civilizations in Egypt, Mesopotamia, the Indus valley, China, the Americas, and Africa, and has been for all later states up to the present day.

In the *Shorter Oxford English Dictionary* (1973), ‘farming’ is defined as ‘the business of cultivating land and raising stock’. It is equated with ‘agriculture’, which is defined as ‘the science and art of cultivating the soil, including the gathering in of the crops and the rearing of livestock’, and is linked with ‘domestication’, described as the action of ‘taming or bringing under control’. (More specifically, domestication can be defined as ‘the evolutionary process whereby humans modify, either intentionally or unintentionally, the genetic makeup of a population of plants or animals to the extent that individuals within that population lose their ability to survive and produce offspring in the wild’: Blumler and Byrne, 1991: 24.) Farming is indeed a mixture of art, science, and business, no matter how small or large the scale at which it is practised. Its primary purpose is of course to produce food, though not just for human consumption—any livestock kept in enclosed conditions also need feeding. Pre-industrial farmers, though, needed to produce many other products as well: materials to meet their needs for shelter, light, heat, clothing, and storage, and shelter and bedding for their livestock. Livestock products and cultivated plants were the primary sources of brewed and fermented drinks and were also important for making medicines, potions, and drugs. Bone, antler, horn, and leather were all vital for making tools and ornaments, as were many plant fibres. Containers could be fashioned from leather, basketry, and in some parts of the world from plants such as cucurbits (gourds). For most farming societies, animal dung is essential for manuring the crop fields, and in many arid lands it is an important source of fuel.

The origins and dispersal of agriculture have been debated by archaeologists for most of the discipline’s history. They have been a particular focus of archaeological field and laboratory research from the middle of the twentieth century onwards. Much of the debate has concentrated on the regions where it has long been assumed that plants and animals were first domesticated from indigenous wild species, the so-called ‘hearths of domestication’ in the Near East (or more properly, South-West Asia), Mesoamerica (a rather ill-defined region consisting of Central America and the parts of North and South America most adjacent to it), and more recently, China. In South-West Asia and China, clear evidence for farming occurs early in the Holocene, when global temperatures rose markedly and there were dramatic changes in weather patterns, sea levels, and terrestrial environments (similar evidence in Mesoamerica is now recognized to be somewhat later). However, farming was not the dominant mode of subsistence in many parts of the world until several thousand years later. Hence most research in Europe, Africa, Asia, and the Americas has focused on questions about processes of ‘agricultural dispersal’:

did farming begin in such regions because the idea of farming was somehow disseminated to the local foraging population from one of the primary farming zones? or because new people—farmers—physically moved into the area from a primary farming zone? or did the local foraging population turn to farming by themselves, unaffected by outside influences, and if so why?

Archaeological evidence for foraging and farming includes: the residues of the plants, animals, and other food sources; inferences drawn from artefacts; signatures of diet in the bone chemistry of skeletons; and pictorial representations of subsistence activities. In recent years DNA studies of genetic diversity in modern populations of humans, animals, and plants, and of DNA in ancient bones and seeds (aDNA), have had a further huge impact on the subject, bringing entirely new perspectives to theories of past population histories and patterns of dispersal (Jobling *et al.*, 2004). Linguistics has further contributed to the debate, with studies of modern linguistic patterning generating further ideas about transitions to farming tied to theories of language origins and dispersals (Bellwood and Renfrew, 2002).

However, to understand the agricultural revolution in prehistory demands not just scientific research on climate, environment, technology, subsistence, demography, linguistics, and so on. In the early twenty-first century, the only contact most people in the developed world—including archaeologists of course—have with the global farming system that produces their food is the supermarket shelf. Farmers in non-industrial contexts, and still more the few people who live (more or less, and increasingly less) as foragers or hunter-gatherers, are known to most of us only from the Discovery TV channel or *National Geographic*. Yet if we are to understand why prehistoric foragers decided to become farmers, we also have to try to imagine how they must have viewed their world and their place within it, issues that are addressed in Chapter 2. To attempt to understand the first agricultural revolution, therefore—to answer questions of how and why, not just what, where, and when—demands a globally comparative study informed by anthropology, social archaeology, archaeological science, and other relevant disciplines. It is a challenging undertaking.

The complex relationship between archaeological theory and practice has been one of the most important features of research on the beginnings of farming. The archaeologist going into the field is asking particular questions about the past, questions which invariably reflect the general theoretical frameworks pervading at the time. The questions being asked affect the kind of methodologies used in the field, prioritizing the recovery of certain classes of information over others. New theories will pose new questions about past societies, and these questions will result not just in reinterpretations of existing data but also in new kinds of data being collected in the field or the

laboratory. New data, whether searched for explicitly or thrown up by unexpected discoveries, feed back into theoretical frameworks. As described in the rest of this chapter, how archaeologists have thought about foraging and early farming societies has had a fundamental impact on the questions they have asked about why people became farmers, the kind of data they have collected, how those data have been interpreted, and the general theories proposed as a result.

BARBARISM TO CIVILIZATION: VICTORIAN LADDERS OF PROGRESS

'A new science has dawned upon us, lighting up the earliest history of mankind. Prehistoric archaeology is the latest to arrive of a series of luminaries that have dispelled the mist of ages, and replaced time-honoured traditions by scientific truths.' With these confident words Hodder Westropp began his Introduction to *Prehistoric Phases* in 1872. C. J. Thomsen's system of classifying the collections of the National Museum in Copenhagen into three 'Ages' of stone, bronze, and iron had been widely accepted as of universal validity for the pre-classical archaeology of the rest of Europe (Daniel, 1964). It soon became clear that the Stone Age should be further divided into an Old Stone Age or Palaeolithic, when flint tools were made by flaking and chipping, and a New Stone Age or Neolithic, when stone tools were also prepared by polishing. The separate identities of these periods, and the immense period of time encompassed by the former, were well recognized by the late 1860s. Palaeolithic artefacts were being found in very old river gravels and in caves, in the latter case alongside the bones of extinct animals such as mammoth, woolly rhinoceros, and sabre-toothed tiger. Neolithic axes were being found in profusion, along with primitive handmade pottery and the bones of domestic animals such as dogs, sheep, and cattle, in burial mounds throughout much of Europe. The evidence suggested that the Old Stone Age or Palaeolithic could be equated with a time of Ice Age hunting, and the New Stone Age or Neolithic with the first farming, or at least with the herding of domestic livestock. Westropp himself also proposed the definition of an intervening phase, a Middle Stone Age or Mesolithic, because in many coastal regions, but particularly in Denmark, archaeologists were reporting mounds of shells containing bones not of extinct Ice Age faunas but of animals, sea mammals, and birds adapted to present-day climatic conditions in Europe, but generally lacking polished stone implements, pottery, or bones of domesticated animals. The implication was that there must have been a period after the Ice Ages in Europe when people were still living by hunting, fishing, and gathering, before the beginnings of herding and farming (Table 1.1).

Table 1.1. Hodder Westropp's 'Tabulation of the Stages of Development of Man and Implements'

Stages of the development of man	Stages of the development of implements		Contemporaneous animals (and plants)
Barbarous	Palaeolithic	Rough flints	Mammoth Rhinoceros tichorinus Cave bear Hyena Reindeer
Hunting	Mesolithic	Flint flakes Flint chipped into shape	Red deer Wild boar Wild ox
Pastoral	Neolithic	Stone implements ground at edge Stone implements all ground and polished	Sheep Ox Goat
Agricultural	Bronze	Arrowheads Spearheads Swords Flat celts Palstaves Socketed celts	Sheep Ox Horse Pig
State	Iron	Celts Spears Swords Arrowheads	Cereals (wheat, barley)

Source: Westropp, 1872.

'It appears', Westropp wrote (1872: 2–3), 'as if there were but one history for every separate people, one uniform process of development for every race, each passing through successive phases, before attaining its highest social development; for every race must pass through the necessary transitional stages before it can arrive at a higher development. These successive phases are the rude and barbarous, the hunting, the pastoral, and the agricultural, corresponding with, and analogous to, the stages of infancy, childhood, youth, manhood in the individual man. This sequence is invariable in man, as an individual and collectively'. The same thesis of a universal cultural progression from primitive hunting to herding to farming to civilization was widely argued by contemporary Victorian prehistorians (e.g. Figuier, 1876; Morgan, 1881; Nilsson, 1868). They provide almost identical descriptions of how they imagined life was like for the Palaeolithic and Mesolithic hunter:

However humiliating it may be to our pride, we must acknowledge that, in the earliest period of his existence, man was scarcely distinguishable from the brute. The desire to

supply his wants absorbed his whole thoughts... He fed on wild fruits, or devoured raw fish, or fought with his fellow, or with the brutes for the carcases killed by them... His life was a continual state of warfare. He fought for everything, for food, for women. (Westropp, 1872: 4–5)

The savage has few other than material wants, and these he endeavours to satisfy only for the moment. To appease hunger for the day; when requisite, to protect his body against heat or cold; to prepare his lair for the night; to follow the instinct of propagation; and instinctively to guard and tend his offspring—this constitutes all his care, all his enjoyment. He thinks and acts only for the day which *is*, not for the day which is *coming*... he is compelled to fish and to hunt, or he must perish. (Nilsson, 1868: lvii)

A hunter is a wild man, his food is wild game; he lives as the tiger lives, catching his prey by his superior cunning, strength and pluck. The flesh of that prey is his food, the skin of that prey is his mantle... He may not build a house, he may not till the ground; he may not tarry in one place, for the wild game which he procures is always flying from his poisoned arrow and his plunging knife; and the law of his existence chains him to the buffalo track. His hand is lifted against everything that lives. (Westropp, 1872: 8–9)

In short, the life of the prehistoric hunter was thoroughly nasty, brutish, and short, a precarious journey through a hostile world in an unceasing search for food (Fig. 1.1).

The evidence of the animal bones in Neolithic burial mounds suggested to most Victorian prehistorians that the Age of Hunting was followed by a Neolithic Age of Pastoralism or Herding. As Figuier's second illustration reproduced in Figure 1.1 shows, it was realized from the discovery of artefacts such as grinders that plant cultivation was probably also being practised on a small scale, but the consensus was that the initial phase of farming must have been dominated by stock-keeping. This was universally regarded as a more primitive form of farming than plant agriculture because of the sedentism assumed to go with the latter and the nomadism or mobility with the former, though the skills of the herdsman (and as Figuier's drawing shows, men were assumed to do the herding) were regarded as a major cultural advance compared with the beast-like skills of earlier hunters (Westropp, 1872: 9–10):

A herdsman is a tame man, his food is milk and cheese, the flesh of goats and of calves. He has to provide for his wants by knowledge, care, and kindness. The cow yields him milk, and the goat yields him cloth; yet he wins these requisites from them, not by murderous cunning but by tender love... When the hunter sharpens his blade, the herdsman has to sharpen his wits, if he would thrive in his acts and increase his flocks.

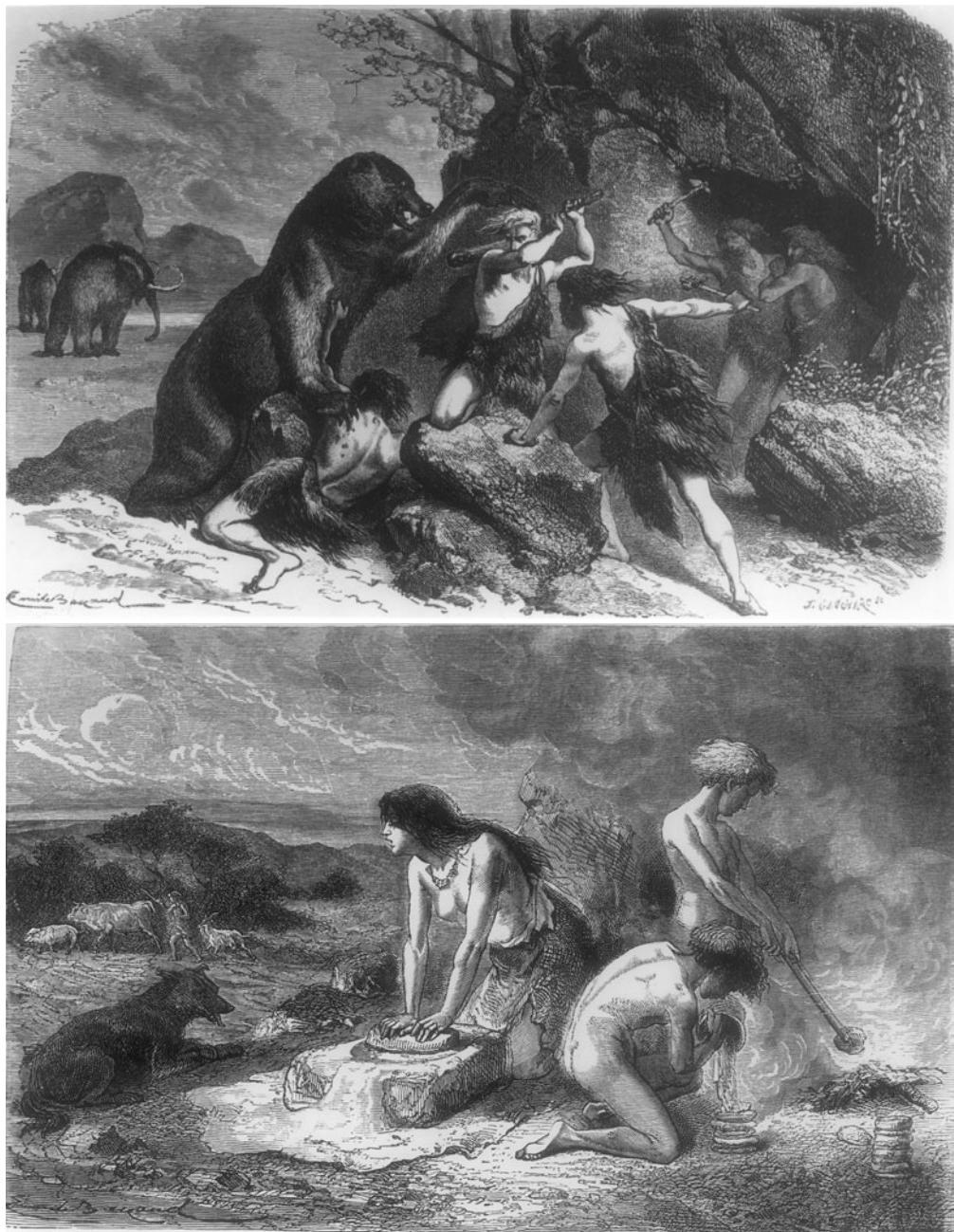


Fig. 1.1. (above) 'Man in the Great Bear and Mammoth Epoch' and (below) 'The Art of Bread-Making in the Stone Age' (after Figuier, 1876: figs. 16 and 125)

Westropp drew analogies with the Bedouin for his pastoralist stage, and with the tribes of the Old Testament, an analogy cited by other European scholars versed in the Scriptures. He suggested that Neolithic people would have lived in tribes divided into clans and families, with their flocks and herds being owned communally.

The beginnings of farming, with people being as dependent on the cultivation of land as on the herding of stock, were regarded as an enormous leap forward in human progress. Farming allowed people not just to settle down and live in one place, but above all to own land and create surplus—the first steps to property ownership and capitalism that were the hallmarks of civilization. Contemporary hunter-gatherers like those of Terra del Fuego known to the Victorians, and by analogy Stone Age hunters, were in a ‘state of nature’, but with the development of agriculture ‘man is in his “natural state”, endowed with the high physical organization and progressive intellect given to him by nature’ (Westropp, 1872: 7–8). Farming, it seemed clear, was the seminal moment in the story of human progress when people first began to use culture to take control of nature. The principal advantage of farming over hunting and herding, it was argued, was in terms of increasing time to do things other than simply seek food to survive: hunters had no time, and herders not much, but farming brought greatly increased opportunities for self-improvement:

When no longer content with the fruit and plants which chance throws in his way, man learns to form a stock of them, to collect them around him, to sow, to plant them, to favour their reproduction by the labour of culture, he becomes stationary and devotes himself to agriculture... Agriculture may be considered the most important step in the development of civilization. (Westropp, 1872: 12–14)

The movable tent gives way to a permanently fixed dwelling; the tilled corn fields yield a richer harvest the more they are cultivated; the forests surrounding his home give him fuel and building materials; the fields provide him with grass and winter fodder for his cattle, and even the waters yield him tribute. The owner cultivates and guards his territory, he has devoted all his care and labour to it; it is his own, he will and ought to possess it for himself and for his descendants... every landowner becomes a man for himself. (Nilsson, 1868: lxx)

When it came to explaining *why* humans had advanced from hunting to farming, the Victorians invariably sought their answers in the uniqueness of the human spirit and in its inherent yearning for progress. Thus Hodder Westropp began his opening chapter (1872: 1, 2): ‘as it is in the nature of the development of man, as an individual and collectively, to be progressive, it must of necessity follow that this development should be from a lower to a higher stage, from the weak, helpless state of infancy, to the maturity

and power of manhood; from a rude and barbarous phase to a more refined civilization... This upward development is the necessary result of the inherent and peculiar progressive power and improvable nature of man.' Man would gradually have become conscious of the advantages of domesticating animals and the sustenance they would provide if he tamed them. Nilsson similarly concluded that eventually Neolithic herders must simply have tired of their wandering lives and understood the many advantages of settling down and becoming farmers (Nilsson, 1868: lviii).

By the closing decades of the nineteenth century, though, there was increasing evidence against the thesis of a universal sequence of development from hunting to herding to farming. Westropp himself, for example, pointed out that there seemed never to have been a pastoral phase in North America, whilst in marginal environments where cultivation was difficult or impossible, such as the steppes of Scythia and Tartary, pastoralism was inevitably the end-point, with 'further progress in development necessarily checked' (1872: 197). In his Introduction, he added a footnote mentioning that he understood that the recent discoveries of the Swiss 'lake villages' exposed by the very dry summer of 1868 included cereal grains as well as animal bones, indicating a swift transition in this region from hunting to farming; and the fallacy of the universal Age of Herding was further exposed by the detailed publication of the Swiss waterlogged settlements (Keller, 1878; Munro, 1890). However, the dichotomy between the hunting and farming lifestyles, the former nomadic, uncertain, and close to nature, the latter sedentary, reliable, and the basis for 'making culture', remained embedded in archaeological thought.

GORDON CHILDE, THE NEOLITHIC REVOLUTION, AND THE 'OASIS HYPOTHESIS'

Without doubt, the dominant intellectual force in the study of Old World pre-history during the first half of the twentieth century was V. G. (Vere Gordon) Childe. Born in Australia in 1892, Childe was appointed the first Professor of Prehistoric Archaeology at the University of Edinburgh in 1927 and then held the Directorship of London University's Institute of Archaeology from 1938 until shortly before his death in 1957. In his professional career he wrote nearly twenty books, including his pan-European survey *The Dawn of European Civilization*, published first in 1925 and successively revised to the sixth edition published the year before his death, but his ideas about how prehistoric societies had developed were best set out in two relatively short books designed for a more popular readership: *Man Makes Himself* (1936), and *What Happened in History* (1942).

It is significant that Childe, whose political leanings were firmly on the left, wrote *Man Makes Himself* at a time of great social upheavals in Europe, all of which were anathema to him: the socially destructive effects of the Depression; the rise of Fascism in Italy, Spain, and Germany; and the Stalinist purges in Russia. His first paragraph in *Man Makes Himself* dismisses the Victorian notion of universal progress (1936: 1): ‘in the last century “progress” was accepted as fact... Now that optimism has received a rude shock... Doubts as to the reality of “progress” are widely entertained.’ In the rest of his opening chapter he emphasized the complex nature of historical truth, and the relativity of notions of progress: the artistic glories of the ancient civilizations, for example, rested on the effective servitude of the masses, and in his own time, science and technology were bringing evident improvements to the lives of ordinary people but were also allowing a re-armed Germany to threaten the rest of Europe. He made a particular point of dismissing as nonsense (‘mystically conceived’) Hitler’s Fascist philosophy of biologically based racial superiority. He argued that, faced with such wilful misuse of history, one of the few undeniable and reliable indicators of genuinely revolutionary change in the past, such as the effects of the Industrial Revolution, was population increase. This would therefore be his guiding principle in his consideration of ‘progress’ in ancient times:

We shall be able to discern in earlier ages of human history other ‘revolutions’. They manifest themselves in the same way as the Industrial Revolution—in an upward kink in the population curve... The chief aim of this book is to examine prehistory and ancient history from this angle. It is hoped that a consideration of revolutions, so remote that it is impossible to get angry or enthusiastic about them, may help to vindicate the idea of progress against sentimentalists and mystics. (Childe, 1936: 14)

In the rest of the book he laid out the evidence for what he regarded as the two most significant revolutions in human prehistory: the invention of farming, which he termed the Neolithic Revolution; and the invention of cities and states, the Urban Revolution. His chapters on the Palaeolithic show how far removed he was from Victorian notions of brute savagery. On the Upper Palaeolithic, the period when fully modern humans, the creators of the cave art, appeared in Europe, he wrote of the ‘prosperity, refinement, and density of population attainable by a hunting and collecting economy’ (Childe, 1936: 64). It remained true, though, that hunter-gatherer culture in Europe then ‘decayed’ in the form in which it survived into the Postglacial or Holocene as the Mesolithic. In the following chapter he presented his ideas about the Neolithic Revolution:

Soon after the end of the Ice Age, man's attitude (or rather that of a few communities) to his environment underwent a radical change fraught with revolutionary consequences for the whole species... [he began] to control Nature, or...at least succeeded in controlling her by co-operating with her... The first revolution that transformed human economy gave man control over his own food supply. (Childe, 1936: 66)

Although he acknowledged that the process of domestication must have eventually involved a wide variety of staple food crops around the world—wheat, barley, rice, maize, yams, sweet potatoes, and so on—his standpoint was that he needed to restrict his discussion to the cereals wheat and barley, the agricultural basis of the ancient civilizations of the Mediterranean, Mesopotamia, and India, as so little was known about the domestication history of the other crops. (Childe never really concerned himself with New World prehistory, for example.)

The first component of his argument was that the Neolithic Revolution must have happened where the wild ancestors of modern domesticated plants and animals were to be found. He knew that wild forms of wheat and barley were to be found from the eastern Mediterranean eastwards to at least Persia (the Iranian plateau), and though he acknowledged that distributions would probably have been altered by climatic change, he concluded that present distributions were probably a reasonable general indicator of past distributions. Significantly, wild goats and sheep of various species ranged over the same area, though their distributions extended outwards from the cereal range, the mouflon sheep in the Mediterranean islands, for example, the urial sheep in Afghanistan, and the argali sheep in the mountains of central Asia. The expectation therefore had to be that the first farming would have started in the 'Near East'.

Secondly, he argued, the fact that the Urban Revolution took place in the same region also made it inherently likely that farming began first here. The two most ancient civilizations of the world were the Sumerian in Mesopotamia (the alluvial plains of the Tigris and Euphrates rivers in Iraq), which developed from about 3500 bc, and the Egyptian in the Nile valley, known to have developed from about 3000 bc (dates based on the historical records of the two civilizations). Both civilizations were founded on agricultural systems based on the cultivation of wheat and barley, and animal husbandry based especially on the herding of sheep and goats. The cultivation systems of both civilizations depended on irrigation, using the natural flooding cycles of the Nile, Tigris, and Euphrates, rivers that together made up what was termed the Fertile Crescent (Fig. 1.2). Presumably, therefore, the beginnings of farming were also to be sought in the Fertile Crescent, before the development of the ancient civilizations.



Fig. 1.2. Gordon Childe's map of 'Areas of Civilization about 2500 bc' (the shaded areas); the Fertile Crescent was the location of the beginnings of farming according to his 'oasis hypothesis' (after Childe, 1936: map 1)

The third and critical plank in the argument concerned the likely effects of changes in climate at the end of the Pleistocene. The melting of the European ice sheets, he suggested, must have had a dramatic effect on global weather systems in the Near East, shifting rain-bearing depressions northwards and so bringing desiccation to the Near East. Even a small reduction in rainfall would have been serious in a part of the world that was always relatively dry. The extensive grasslands of Pleistocene times in the Fertile Crescent region would gradually have developed into a landscape of sandy deserts and isolated oases. As the landscape became more desiccated, both animals and people would have had to congregate in oases around the diminishing number of springs and streams, 'united in an effort to circumvent the dreadful power of drought' (Childe, 1936: 77). Each would have become accustomed to the other's proximity. As Near Eastern hunters were by now also cultivators, the circumstances were in place for people to realize the benefits of protecting and managing ('husbanding') animals instead of just hunting them. This is what scholars have termed Childe's 'oasis hypothesis':

The stubble of his freshly reaped fields will afford the best grazing in the oasis. Once the grains are garnered, the cultivator can tolerate half-starved mouflons or wild oxen

trespassing upon his garden plots. Such will be too weak to run away, too thin to be worth killing for food. Instead, man can study their habits, drive off the lions and wolves that would prey upon them, and perhaps even offer them some surplus grain from his stores. The beasts, for their part, will grow tame and accustomed to man's proximity... If he just realizes the advantage of having a group of such half-tamed beasts hanging round the fringes of his settlement as a reserve of game easily caught, he will be on the way to domestication. Next he must exercise restraint and discrimination in using this reserve of meat... Once he begins to kill only the shyest and least amenable bulls and rams, he will have started selective breeding. (Childe, 1936: 78)

By learning how to cultivate and herd, and to combine the two in systems of mixed farming, people were able to live in settled villages, and multiply rapidly. They invented new crafts such as potting and making textiles, and traded with each other. The nature of Neolithic agriculture favoured movement, and the combination of semi-nomadic farming and rising populations, Childe believed, took the Neolithic Revolution from South-West Asia as a movement of people (Neolithic farmers) westwards right across Europe to the Atlantic and Baltic, south from the Nile into Africa, and eastwards eventually to India. He was careful to emphasize that the eventual change from hunting to farming was probably the climax of a long process, but he argued that, in the scale of the economic, social, and demographic change it represented, it surely remained a true revolution, the first in human history and the most profound in its consequences as the platform on which urbanism was created.

Childe added little detail on the possible causes of the Neolithic Revolution in *What Happened in History* (1942), but there were significant changes in his thinking on what had happened, and more precision about when. Written in the darkest years of the Second World War, *What Happened in History* encompassed the entire sweep of human history from earliest prehistory to colonialism and capitalism. The transition from hunting to farming is discussed in two chapters entitled Palaeolithic Savagery and Neolithic Barbarism. Again, Childe emphasized the value of population growth as the prime indicator of revolutionary change. Upper Palaeolithic hunters in Europe had produced 'a dazzling culture... that supported a substantially increased population', but it depended on a narrow economic base, the hunting of steppe animals such as reindeer, and when the glaciers retreated and numbers of reindeer declined, the culture simply 'withered away', to be succeeded by Mesolithic societies 'of extreme poverty' (p. 43). The inability of the hunter to increase his food supply was 'the inherent defect of savagery as an economy' (p. 45). The invention of farming was the economic and scientific revolution that allowed people to escape this impasse, making people 'active partners with nature, instead of parasites on nature' (p. 48).

Excavations had recently been published of caves in Mount Carmel in what is now northern Israel (Garrod and Bate, 1937). They contained evidence for early Holocene hunter-gatherers (termed 'Natufian' people) who were equipped with flint tools like those of the European Mesolithic and who were also using sickles made of flint blades mounted in wooden or bone handles. The lustre on the flint blades showed that they were being used to cut grass or cereal stems. Though Childe acknowledged that this evidence did not point definitely to agriculture—cutting wild grasses would produce the same lustre—it seemed reasonable to suggest that Natufians were becoming cultivators. Analogies with recent hunter-gatherers suggested that men were commonly the hunters and women the gatherers, so Childe concluded that it was the Natufian women who became the cultivators, the men in time becoming herders in the way he had described in *Man Makes Himself*.

Though he could put no absolute date on the Neolithic Revolution, he was at least able to bracket it more precisely. The end of the Pleistocene some 10,000 years ago was the *terminus post quem*. An approximate *terminus ante quem* could be calculated from the depth of occupation deposits being found by excavations of big *tell* or mound sites in the Near East such as Tepe Sialk, Tepe Gawra, and Ras Shamra, sites with occupations lasting into Sumerian and later times, hence with their upper levels more or less reliably dated. Tell deposits consist largely of collapsed dwellings made of mud or mud-brick, the growth of the tell being due to the fact that a house made of such materials would last a generation or so, fall into disrepair, and be levelled to the ground, raising the ground level on which its successor was then built. The depth of the pre-Sumerian levels suggested at least a thousand years of earlier prehistoric occupation, and the sophistication of the earliest pottery found in them indicated that the basal layers represented a relatively advanced stage of the Neolithic. Hence he calculated that 4500 BC seemed a reasonable *terminus ante quem* for the Neolithic Revolution in South-West Asia.

In *What Happened in History*, as in *Man Makes Himself*, Childe remained vague as to precisely how and why the hunters and gatherers of South-West Asia made the critical switch to farming, beyond suggesting that the advantages of cultivating and herding would simply have become obvious to them given the stress they were under from postglacial desiccation, and the effects of the latter in clustering people, cereals, and animals by springs in oases. However, as well as developing the theory of the Neolithic Revolution and the 'oasis hypothesis', these books were also important for the many other ideas they developed about the nature of prehistoric forager and farmer societies, ideas representing an enormous advance in understanding compared with the Victorians, and which have helped shape the development of studies of the origins of agriculture ever since (Chapter 2, pp. 44–6).

CULTURES AND CULTURAL FRAMEWORKS

In the opening chapter of *What Happened in History*, Childe explained his concept of the prehistoric ‘culture’, which he regarded as the essential building block in the task of reconstructing the prehistoric past. Recurrent types of artefacts and other aspects of material culture such as tomb and house types ‘current in a restricted area at a given period in archaeological time’ (p. 19) could be assumed to equate with a social grouping larger than the individual household, extended household, or clan, such as a tribe. Prehistoric cultures, in short, should represent separate peoples. This ‘culture concept’ established a new and powerful theoretical framework for regional typological studies, and he devoted the greater part of his research career to establishing regional cultural sequences (mostly in Europe) and establishing cross-regional linkages. A vital purpose of the latter was to establish chronology, by ‘cross-dating’ prehistoric cultures with historically dated societies. For example, the famous Bronze Age settlement of Troy in north-west Turkey could be dated to c.3000 BC because of demonstrable links with Pharaonic Egypt, and Childe used the links he thought he could see between Troy and Balkan Neolithic cultures to posit 3000 BC as the date for the beginnings of farming in Europe. By the end of his career he had established a comprehensive scheme of prehistoric cultural sequences for every region of Europe from the beginning of the Neolithic to the end of the Iron Age (Childe, 1957), the principal components of which survive today.

There were, however, drawbacks to this kind of ‘cultural prehistory’, especially for the study of transitions from hunting to farming. The first was that, in the way European prehistory in particular came to be studied, cultural prehistory effectively divided the archaeology of hunter-gatherer societies from that of agricultural societies. Put crudely, Palaeolithic and Mesolithic archaeologists had flints and bones to study whereas Neolithic archaeologists had culture(s), and increasingly few prehistorians spanned that divide. Secondly, culture was what people *had*, not what they *did*, so many sites with the kind of material culture assumed to belong to farmers (Neolithic pottery and polished stone tools especially) were assumed to be farmers’ settlements because of the material culture, rather than because of any direct evidence that the people at the site cultivated plants or herded livestock. Thirdly, without access to modern absolute dating methods as a control, the establishment of relative chronologies using typological comparisons inevitably created ‘chest of drawers’ sequences of apparently contemporary cultures marked especially by changing pottery styles. When it came to explaining the change from foraging to farming, therefore, the answer was implicit in the cross-regional typological links used to establish the regional cultural sequences in the first

place: *ex oriente lux*, from South-West Asia via the eastern Mediterranean into the rest of Europe. Farmers must have migrated westwards, carrying Neolithic culture with them. In some instances, perhaps, ideas about farming might have spread ('diffused') from one region to another, with hunters seeing the advantages of farming and adopting Neolithic culture in the process.

An important if speculative book about the beginnings of farming published towards the end of Childe's career was Carl Sauer's *Agricultural Origins and Dispersals* (1952), which attempted to shift the focus of interest to South-East Asia. Sauer started out by positing that the beginnings of farming would be found amongst societies meeting a number of conditions. They would have a flourishing economic base, relying on gathering more than hunting (as gathering would mean detailed knowledge of, and a pre-disposition to experiment with, plants), and on fishing (which would together allow them to be more or less sedentary). They would not be in major river valleys, where crop farming would be difficult because of flooding. They would be living in wooded rather than open country, because woodland soils could be cultivated with simple digging tools, whereas grassland turf could not. The location would have a wide variety of plants, fish, and animals. These conditions came together in South-East Asia. It must have been people here, he concluded, who first began cultivating root crops, then domesticating animals such as dogs and pigs. There was very little archaeological evidence in support of his theory at the time he was writing, but he suggested that the absence of evidence was because the prime coastal locations where agriculture had been invented were now under water, flooded by the higher sea levels caused by the melting of the glaciers at the end of the Pleistocene. He believed that the 'idea' of farming then spread westwards throughout the Old World, stimulating different societies to domesticate other crops and animals. Perhaps the idea of farming had also crossed the Pacific to the New World, or perhaps the Caribbean had been a second centre where farming was invented amongst coastal fisher-gatherers (the same arguments about coastal flooding could be used to explain the absence of evidence there!). Although the book was strong on speculation and short on data (to put it mildly), it is interesting how in many respects modern research in mainland South-East Asia and Island South-East Asia is supporting Sauer's ideas about the precocious nature of foraging-farming transitions in this part of the world (Chapter 6).

Childe was unconvinced about his oasis theory towards the end of his life, aware of new discoveries in South-West Asia of early farming communities not in the great river valleys but in the adjacent mountains. Also, in the later editions of *The Dawn of European Civilization* he pointed to evidence in many parts of Europe for Mesolithic foragers contemporary with, and in contact with, Neolithic farmers, each acquiring components of the other's material

culture through barter or warfare. Clearly there was a need for caution in making simple equations between Mesolithic material culture and hunting-gathering, on the one hand, and Neolithic material culture and farming on the other. Many contemporary cultural prehistorians, however, did not bring the same subtlety to the evidence. To be fair, though, throughout Childe's research career most prehistorians had to put most of their effort into establishing *when* things took place, not *how* or *why*. Childe's death coincided more or less exactly with the publication by Libby of the first absolute dates obtained by the radiocarbon (or Carbon-14 or 14C) method, heralding a revolution in dating that promised to free prehistorians to concentrate increasingly on the 'how' and 'why' questions of the change from foraging to farming. With the invention of radiocarbon dating a prehistoric site could now be dated independently of its neighbours, so the potential was there to establish with some precision the extent to which cultural change in one region did or did not run in parallel with change elsewhere as the chest-of-drawers model of cultural change had invariably suggested (Renfrew, 1973).

ARCHAEOLOGICAL SCIENCE AND 'HEARTHS OF DOMESTICATION'

The study of the origins of agriculture was revolutionized in the late 1950s and 1960s by the application of archaeological science. A good indicator of the pace of development in archaeological science at this time is a comparison of the two editions of *Science in Archaeology*, a collection of essays edited by Don Brothwell and Eric Higgs, first published in 1963 and in a greatly revised version in 1969. The essays describe the many scientific techniques that were becoming available for dating past events, reconstructing past climates and environments, using physical and chemical methods to analyse artefact construction and provenance, and studying plant, animal, and human remains to reconstruct domestication processes, diet, and subsistence. Addressing the problem of the origins of agriculture was a critical stimulus in the development of many of the techniques described in the book and the focus of many of their applications.

In both the Old and New Worlds, studies were undertaken of the modern distributions and biology of the plants and animals that were thought to be the 'wild progenitors' of domesticated plants and animals. From comparisons between modern wild and domestic species, 'archaeozoologists' and 'archaeobotanists' (archaeological specialists studying animal bones and plant remains respectively) proposed criteria for recognizing signs of domestication in archaeological material. These approaches came together in the late 1950s

and 1960s in a series of archaeological expeditions, mainly led by North American archaeologists, in search of the origins of agriculture. The teams represented a new kind of interdisciplinary archaeology, with archaeozoologists and archaeobotanists working alongside the excavators. Many of the projects also combined survey with excavation, and where possible lake sediments were investigated for their pollen records. Although the senior player in this programme, Robert Braidwood, was particularly concerned to disprove Childe's oasis theory, a critical stimulus for most teams was the essay published in 1926 by the Russian botanist N. I. Vavilov, *Studies on the Origin of Cultivated Plants* (interestingly quoted by Childe in neither *Man Makes Himself* nor *What Happened in History*). Vavilov had argued that the centre of origin of a crop was likeliest to be where the greatest genetic diversity was found today (now known, in fact, to be not necessarily true), as well as supposed wild ancestors or progenitors. On this basis he proposed eight primary centres, and several sub-centres (Fig. 1.3). Two regions in particular were suggested as the most likely candidates for the earliest farming: South-West Asia in the Old World, for the domestication of wheat and barley; and Central America

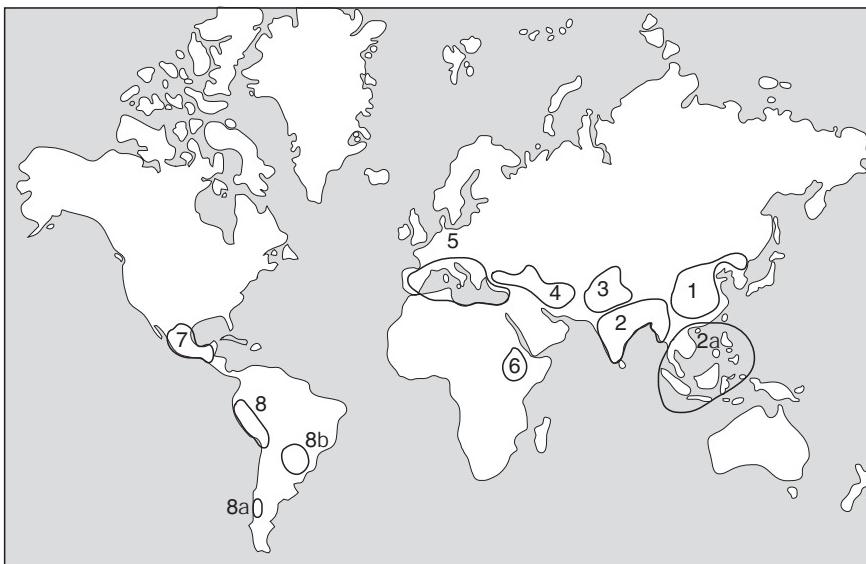


Fig. 1.3. Centres of origin of major crops, as hypothesized by N. I. Vavilov in 1926 on the basis of areas of greatest genetic diversity today:

1. East Asia;
2. South Asia;
- 2a. South-East Asia;
3. Central Asia;
4. South-West Asia;
5. Mediterranean basin;
6. Ethiopia;
7. Central America;
8. coastal Ecuador and Peru;
- 8a. Chilean archipelago;
- 8b. *pampas* grasslands of Uruguay and Paraguay (after Harlan, 1995: fig. 2.1)

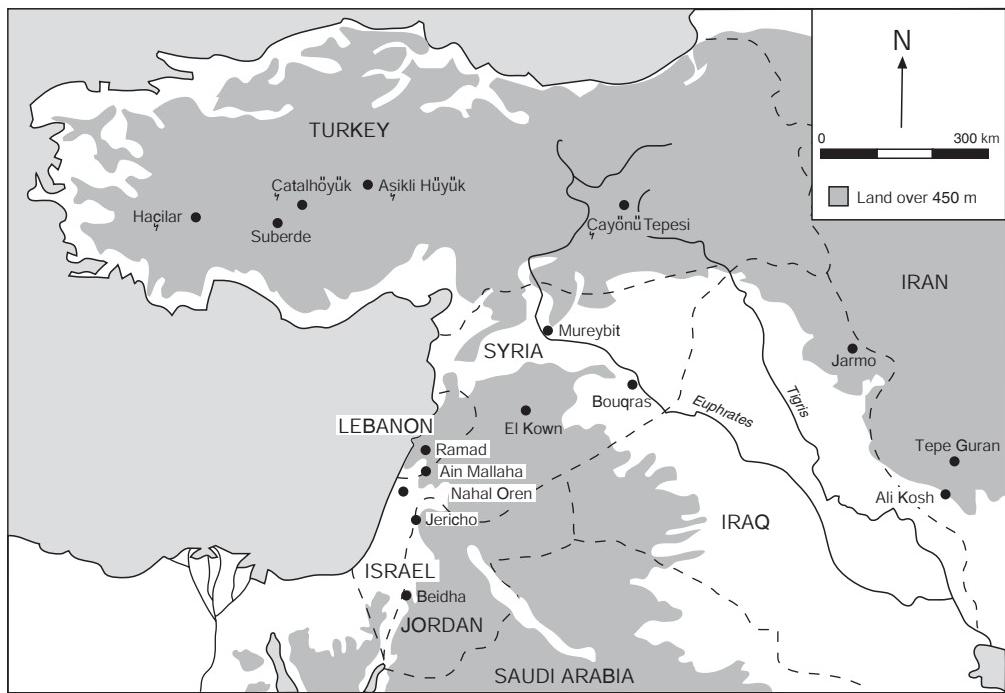


Fig. 1.4. The major early farming sites in the 'hilly flanks of the Fertile Crescent' excavated in the 1950s and 1960s (after Bender, 1975: fig. 19)

('Mesoamerica' as it came to be termed in the archaeological literature), for the domestication of maize.

In the Near East, the focus of the projects was not the Tigris and Euphrates plains but the surrounding hills—what came to be termed the 'hilly flanks of the Fertile Crescent' (Fig. 1.4). Because modern wild cereals and sheep and goats were all upland species, the argument was that they would have been domesticated in the hills, not down on the plain. In his original objections to the oasis hypothesis, Braidwood (1960) had pointed out that, even if wild cereals, sheep, and goats had been down on the plain in the Pleistocene, they would have migrated upwards into the hills in response to postglacial desiccation, not retreated to lowland oases. In any case, however, pollen analyses from the region were indicating that the early Holocene climate was characterized not by desiccation but by a warmer and wetter regime than in the Late Glacial, suggesting that the oasis hypothesis, at least in the form proposed by Childe, should be abandoned (H. Wright, 1960, 1968; van Zeist, 1967; van Zeist and Wright, 1963).

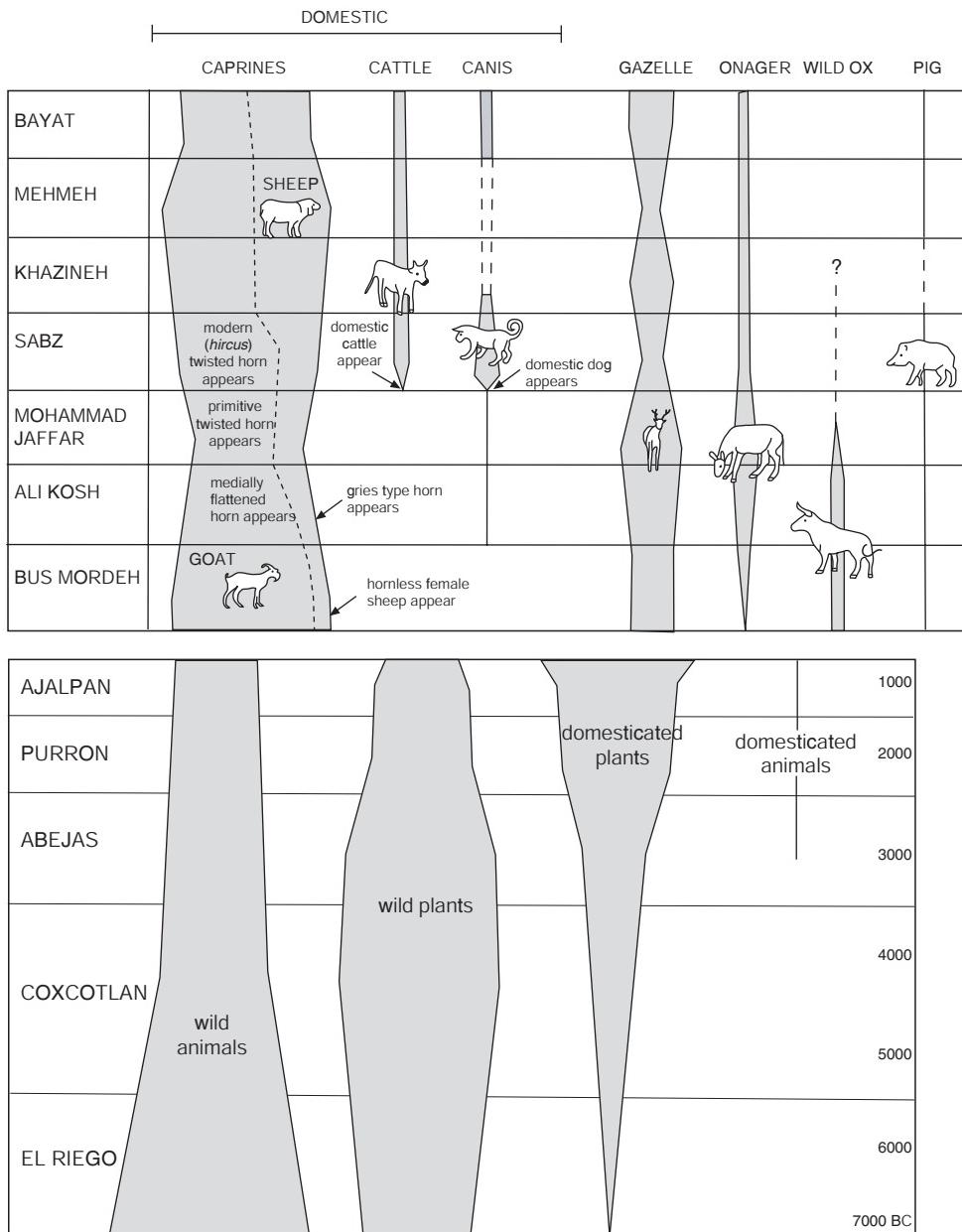
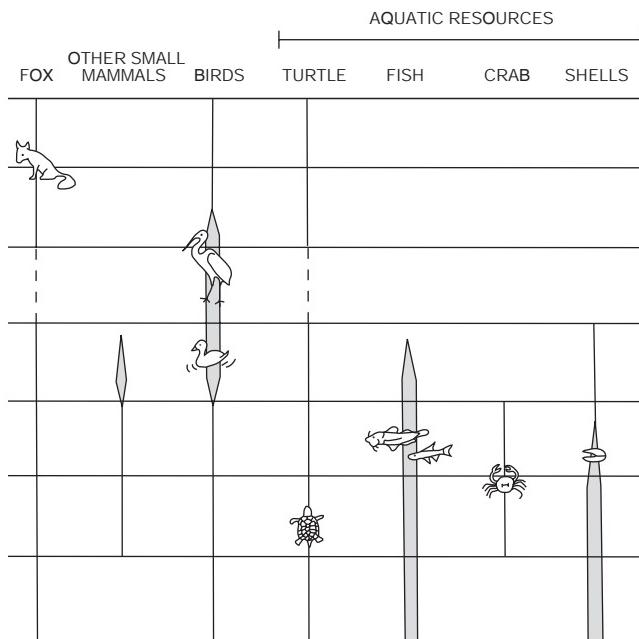


Fig. 1.5. 'Pathways to agriculture': changes in subsistence as reconstructed (above) on the Deh Luran plain, Iran, and (below) in the Tehuacán valley, Mexico (Deh Luran: after Hole and Flannery, 1967: fig. 12; Tehuacán: after Bender, 1975: fig. 29)



Braidwood led an expedition to Kurdistan in Iraq. An area was searched for appropriate early farming sites, and several sites were tested, but the most important excavations of his team were of a settlement at Jarmo (Braidwood and Howe, 1960). The site consisted of a cluster of small mud-built houses, with evidence for domesticated cereals (the so-called ‘primitive wheats’ einkorn and emmer, and barley) and animals (cattle, pigs, sheep, goats, and dogs). 14C dates placed the occupation of the site in the seventh millennium BC (using today’s calibrated chronology, we would add several centuries to the dates, putting the occupation nearer to c.7000 BC). What was also interesting about the Jarmo community was that, though they understood the principles of firing clay for making figurines, they did not make pottery—they had an ‘aceramic Neolithic’ or a ‘pre-pottery Neolithic’ culture. Other teams reported evidence for early farming communities of similar antiquity, for example at Jericho (Kenyon, 1959, 1960) in Israel, Beidha (Kirkbride, 1966) in Jordan, Cayönü Tepesi (Perkins, 1973; Perkins and Daly, 1968) and Haçilar (Mellaart, 1965, 1970) in Turkey, and Tepe Guran (Mortenson, 1963) in Iran. At Ali Kosh on the Deh Luran plain of south-west Iran, cereal farming seemed to begin even earlier, perhaps by 1000 years, though the people still depended mainly on hunting and gathering (Hole and Flannery, 1967; Hole *et al.*, 1969; Fig. 1.5). The Jarmo and Ali Kosh teams had also found earlier Holocene settlements

belonging to people who seemed to be more or less sedentary but who were still living by hunting and gathering. Kathleen Kenyon had found evidence for a similar community underneath the aceramic Neolithic village at Jericho, and other Natufian sites of this kind had been investigated elsewhere in Palestine, at 'Ain Mallaha (Perrot, 1960) and Nahal Oren (Stekelis and Yizraeli, 1963). The evidence seemed persuasive that archaeological science had identified the transition from hunting and gathering to farming in the Old World, widely distributed across the uplands of South-West Asia, a few thousand years after the end of the Ice Age.

Comparable programmes developed at the same time in the New World, though work concentrated on the recovery of botanical remains. (Prior to European colonialism the only indigenous domesticated stock in the New World were llamas, alpacas, vicuñas, and guinea pigs, which were restricted to the Andean zone and played a far less important role for most farming communities than domestic stock did in other regions of the world.) The equivalent of Braidwood's pioneering Iraq-Jarmo Project was the Tehuacán Archaeological Botanical Project, a survey and excavation programme led by Richard MacNeish in the Tehuacán valley in the highlands of south-central Mexico (MacNeish, 1964a, 1964b, 1965; Fig. 1.5). One of the reasons for selecting the Tehuacán valley was that plant remains were well preserved in the arid conditions there, not only in the form of discarded food remains but also within desiccated human faeces or coprolites (Callen, 1969). The first remains of domesticated plants were found at sites dating to c.7000–5000 BC (uncalibrated), including the squash *Cucurbita mixta* and avocado *Persea americana*. Maize pollen was also found in this phase, but the first definite evidence for cultivated maize was in the Coxcotlan phase c.5000–3400 BC, together with domesticated beans, gourds, chilli, and other squashes. This was also the first period when people were thought to be relying on farming for the first time more than hunting and gathering. MacNeish found a somewhat comparable sequence in the Tamaulipas valley in north-eastern Mexico near the Gulf coast (MacNeish, 1958). In the Ayacucho basin in the Peruvian Andes, he found evidence for initial plant cultivation beginning on a small scale in the period 6500–5500 BC, horticulture becoming more established in the period 5500–4300 BC, and maize farming developing after that (MacNeish *et al.*, 1970). Other field programmes on the coast indicated that foragers there had started to cultivate plants (bottle gourds and a squash) by c.4000 BC, with maize cultivation eventually being established by c.2000 BC (Lanning, 1967; Patterson, 1971). At Bat Cave in New Mexico, there were remains of primitive corn cobs, gourd rinds, pumpkin seeds and rinds dating to c.2000 BC (Mangelsdorf and Smith, 1959).



Fig. 1.6. 'Hearths of domestication' in the New World as they appeared in the 1960s (after MacNeish, 1965: 89)

In a summary of the New World data, MacNeish (1965) offered three principal conclusions (Fig. 1.6). First, the evidence appeared to suggest multiple origins of domestication: 'not only were different crops originally domesticated in different regions...but the same plants in some cases may have been independently domesticated in different regions'. Second, the process seemed always to consist of a gradual process of experimentation before people finally committed themselves to becoming farmers. Third, there was no Neolithic Revolution, in the sense of a sudden switch from a hunting and gathering technology to a 'Neolithic package' of domesticated plants and animals, ground and polished tools, and pottery: 'it took some 6000 years ... for the "Neolithic" traits to evolve into a single complex'. The evidence from South-West Asia pointed to similar conclusions, with early

farming developing in widely dispersed regions (Palestine, Turkey, Iraq, Iran) over several thousand years, with no sudden development of the 'Neolithic package'. As an undergraduate sitting my final examinations in the late 1960s, the one examination question I knew I could guarantee to have to answer was: 'The Neolithic Revolution was neither Neolithic nor a Revolution. Discuss'.

Grahame Clark, Disney Professor of Archaeology at the University of Cambridge from 1952 to 1974, was by general consent the only British prehistorian of their generation to rival Gordon Childe. His writings were characterized not just by an interest in what might be termed 'ecological' rather than 'cultural' prehistory but also by an interest in the development of prehistoric societies at the global scale (Rowley-Conwy, 1999a). The enormous acceleration of knowledge about the appearance of early farming as the first suites of radiocarbon dates emerged in the 1960s is exemplified in the changes made in the successive editions of his *World Prehistory* (Clark, 1963, 1969, 1977). In Europe, the main surprise was how old the oldest Neolithic dates were: the earliest sites with evidence for farming, c.6000 BC in Greece, were twice as old as Childe's postulated date for the beginnings of the European Neolithic. However, the general drift in the dates from c.6000 BC in Greece to c.3000 in north-west Europe appeared to confirm Childe's general hypothesis, that agriculture was introduced to Europe by Neolithic people from the Near East, spreading across the continent in search of new land (J. G. D. Clark, 1965; Fig. 1.7). The same interpretation was drawn from the first radiocarbon dates from North Africa, the theory being that Neolithic people moved from the Near East into the Nile valley and thence c.3500 BC westwards across the Sahara (evidence suggesting the climate was wetter then) and southwards across the Sahel (Hugot, 1968). Population movements eastwards from the Near East were also envisaged to explain the first farming sites in central Asia, Pakistan, and India, also dating to c.3500 BC (Masson, 1961). China was effectively closed to western scholars at this time, and knowledge of early farming still depended largely on published discoveries from before the Second World War, but rice cultivation was known to have been practised by the people of Yang Shao Neolithic culture, 14C-dated to c.3000 BC (K.-C. Chang, 1970). Little was understood about the beginnings of farming in South-East Asia and the Pacific, but it was generally believed that it was introduced by Neolithic colonists from Asia (Gorman, 1969). In the New World, maize farming was thought to have spread from Mesoamerica into the American South-West and Peru, though whether by knowledge diffusion or population movement was unclear (MacNeish, 1965).

The state of knowledge was summarized in the proceedings of a major international seminar held in London (Ucko and Dimbleby, 1969). There were general papers on the ecological context of domestication, and on methodologies for recognizing the domestication process in plants and animals.

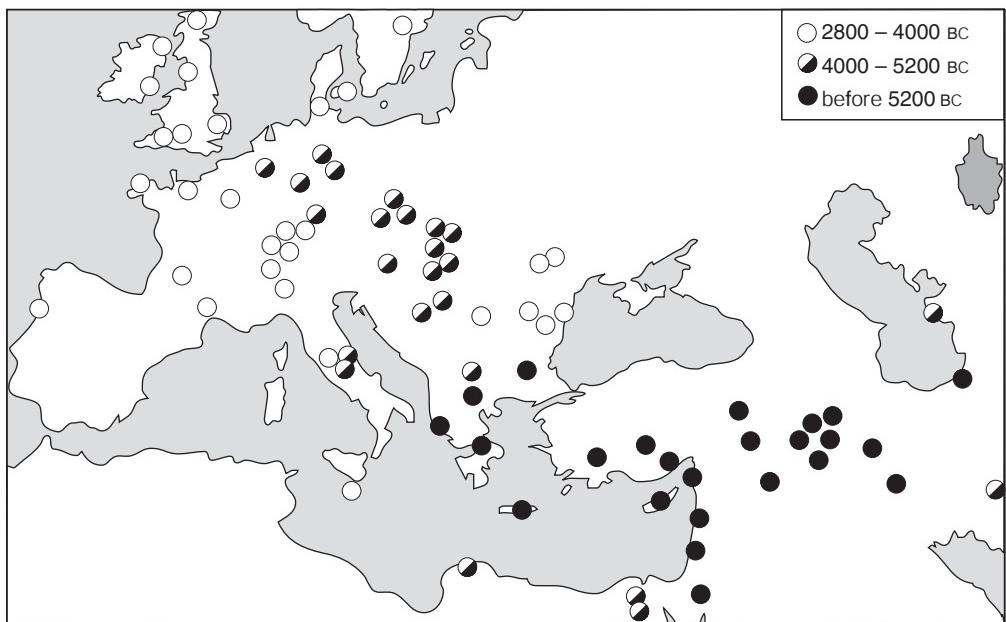


Fig. 1.7. The spread of farming from South-West Asia into Europe according to the first series of radiocarbon dates (after Clark, 1965: fig. 2)

On South-West Asia, there were seminal papers on what was understood about the distribution and composition of the ‘wild progenitors’ of the domestic cereals and their relations to early domesticated versions, on Holocene environmental change, the archaeobotanical and archaeozoological evidence, and a major synthesis by Kent Flannery. The New World plant domestication sequences were also discussed. Botanical and faunal data for some parts of Europe were comparatively detailed, but for most other regions of the world were still exiguous, either because of the limitations of fieldwork as in the case of South Asia and China, or because of the difficulties of obtaining archaeological evidence as in the case of African root crops. The consensus was that agriculture had developed early in the Holocene in a few restricted ‘hearths of domestication’ and then spread rapidly to other regions, mostly by a process of colonization.

Braidwood and his team had started out expecting to find evidence that environmental change was a significant factor in the adoption of farming, but because the major climatic changes at the Pleistocene–Holocene boundary were manifestly earlier than early farming villages such as Jarmo, he concluded that the reasons must have been cultural (Braidwood, 1960). Final Palaeolithic

populations had begun to broaden their subsistence base (what was termed 'broad spectrum' hunting and gathering) in response to the environmental changes of the Pleistocene–Holocene transition. Their technology became more efficient, so people were able to extract more food from a given environment. Thus the stage was set for experiments with some of the plants and animals already being exploited, a short step away from husbandry. 'Why did incipient food production not come earlier? Our only answer at the moment is that culture was not yet ready to achieve it' (Braidwood and Howe, 1960: 342).

THE NEW ARCHAEOLOGY AND 'PATHWAYS TO AGRICULTURE'

The 1960s witnessed major changes in archaeological philosophy that were generally characterized then as the New Archaeology, changes that were in parallel with those in other disciplines such as geography (Johnson, 1999). The proponents of the New Archaeology argued that the discipline needed to become less like the humanities and more like the sciences in terms not simply of methodologies but also theoretical procedures (Binford, 1962, 1964; Clarke, 1968). Using scientific principles of hypothesis testing, it was argued, the past could be reconstructed in terms of *systems* of social and economic behaviour and *processes* of change in such systems (hence the other term for New Archaeology has become Processual Archaeology). Whereas cultural prehistorians had looked mostly to migration and diffusion as explanations for change, the New Archaeologists viewed cultures as adaptive systems and commonly sought explanations for cultural change either in external factors such as environmental change or the impact of new technologies, or in factors internal to a society such as population stress, social disintegration, elite competition, and so on. Implicit in New Archaeology's interest in process was a focus on long-term settlement histories ('diachronic change') and regional, rather than single-site, studies to understand settlement systems, interests that stimulated the development of multi-period regional projects integrating survey and excavation. The origins of agriculture became one of the principal theatres of engagement of the New Archaeology. The Tehuacán, Jarmo, and Deh Luran projects were typical in their integration of survey with excavation, of settlement archaeology with environmental archaeology, and their focus on the reconstruction of long-term demographic trends, settlement systems, and subsistence practices, to produce regional accounts of sequences of subsistence change, or 'pathways to agriculture' (Fig. 1.5). In terms of theoretical debates about why foragers might have become farmers,

two North American ‘New Archaeologists’ were particularly influential: Lewis Binford, and Kent Flannery.

The possible effects in South-West Asia of climatic change on population numbers, and of rising populations on subsistence systems, were debated in a famous paper by Binford (1968). He argued that population growth and food resources would generally have been in equilibrium in the Pleistocene, below the population-carrying capacity of a region. The rise in sea levels at the end of the last glaciation would have prompted food collectors living in coastal locations to rely increasingly on fish, migratory birds, and shellfish. As a result, they would have become more sedentary, and their numbers would have started to increase. To relieve population pressure on resources, some of these people would then have migrated into the adjacent, less populated, zones. Migration would have pushed population numbers above carrying capacity, necessitating subsistence intensification. The upland subsistence system already included the gathering of wild cereals and the hunting of wild sheep and goats, so new forms of exploitation—husbandry—were developed to produce more food.

There were many question marks about the model: the likely impact of sea-level rise on the subsistence behaviour of coastal populations was unclear, and there was little or no archaeological evidence for the proposed migration into the hills. But the general thrust of the argument, of agriculture likely in some way to be the outcome of complex interrelationships between environmental change, changes in foraging behaviour, changes in settlement patterns (especially increasing sedentism), and rising population levels at the Pleistocene–Holocene transition, has continued to be one of the most robust and long-lasting theories emerging from the New Archaeology (Layton, 1999).

Flannery explored these relationships in two papers on the beginnings of farming in South-West Asia in which, applying systems theory, he emphasized how complex interactions (‘positive feedback mechanisms’) were more likely to generate change than linear sequences of single causes producing single effects (Flannery, 1965, 1969). Late Pleistocene foragers in South-West Asia practised a ‘broad spectrum’ subsistence system well adapted to a region of great environmental diversity: harvesting wild cereal grasses, nuts, and legumes; hunting sheep, goats, and deer; and collecting a range of smaller species such as fish, land snails, shellfish, turtles, and crabs. They were at least partly sedentary, with high population levels. With the onset of the Holocene temperatures began to rise, allowing woodland to increase and also favouring the wild cereals. Harvesting the latter, however, would have required tight scheduling and an appropriate technology for harvesting (sickles), processing (grinders), and storage (silos), so people would only have started relying on them by necessity, not choice. Flannery accepted Binford’s general thesis,

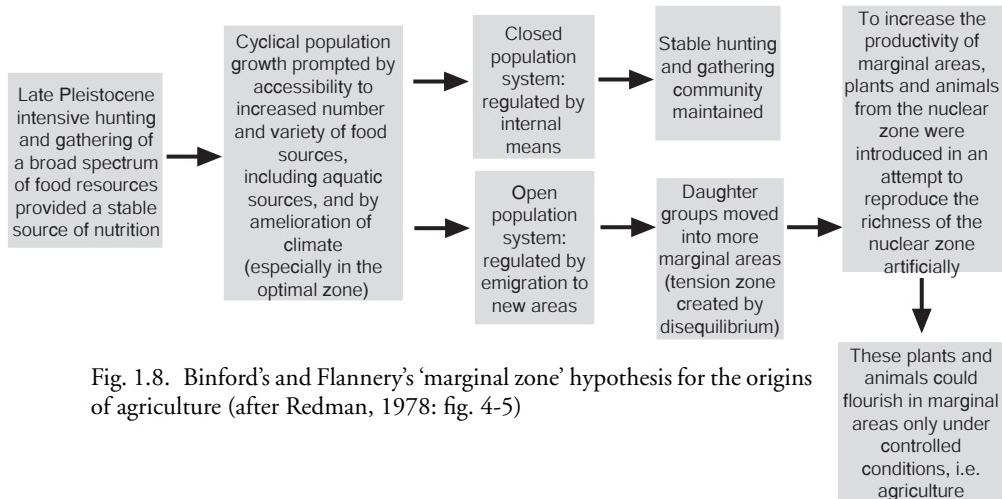


Fig. 1.8. Binford's and Flannery's 'marginal zone' hypothesis for the origins of agriculture (after Redman, 1978: fig. 4-5)

that Late Glacial environmental changes put existing broad-spectrum systems under pressure (though again, he was rather imprecise about exactly how), but he suggested that it would have been in the marginal zones that people would have been forced to intensify, whereas those in optimal resource-rich zones would have been able to cope (Fig. 1.8). That such subsistence intensification took place at this time, he suggested, was indicated by the relatively sudden appearance c.10,000 BC of harvesting and grinding equipment. The really significant change, though, was when people started soon afterwards to move plants and animals from their natural habitats to new ones (as for example to Ali Kosh, the site he excavated at the foot of the Zagros hills). He developed a feedback model on the same principles to account for the transition to farming and the development of social complexity in Mesoamerica (Flannery, 1968).

The starting point for both Binford and Flannery was that there had to be a strong reason for people to abandon foraging and commit to farming. This perspective, developed also by Harris in two review papers (1969, 1973), was in striking contrast to the main thrust of so much previous thinking about the origins of agriculture, that the reason foragers decided to become farmers was that they eventually realized the many obvious benefits it gave them in terms of secure food supply, leisure, and so on. Perhaps the defining event in this process of reappraisal was a seminar on modern hunter-gatherer societies entitled *Man the Hunter* (Lee and DeVore, 1968a) that destroyed the long-lived belief amongst most archaeologists that the hunting-gathering way of life was a desperate, uncertain, and perpetual search for food, to be contrasted with a farmer's life of security, ease, and leisure. One of the most

influential papers was Richard Lee's on the lives of !Kung-San 'Bushmen' in the Kalahari desert, memorably entitled 'What hunters do for a living, or how to make out on scarce resources' (Lee, 1968). Though nomadic, these people had a highly organized and predictable schedule of seasonal movements to exploit particular food sources. Also, they had no problem finding enough food—they had both preferred foods and less attractive contingency foods if supplies of the former ran low. Most striking of all was the fact that, in one of the most inhospitable places on earth for human settlement, collecting food only took a few hours a day, so most people spent most of their time at leisure—gossiping, gambling, and visiting relatives! Of course there was a downside: because they needed to stay mobile, the !Kung-San could own very few possessions, and given the need to keep their numbers in equilibrium with their food supply, infanticide was quite common. But *Man the Hunter* was an important reminder to prehistorians that the advantages were not wholly on the side of the farmers: simplistic explanations for the origins of agriculture on the lines of 'the advantages would have been obvious to any hunter-gatherer' were clearly inappropriate.

Another oft-quoted piece of field research at this time fuelled such scepticism. Using a prehistoric sickle, the botanist Jack Harlan (1967) harvested some wild einkorn wheat in Turkey, collecting a kilogram of clean grain in an hour. At this rate, he calculated, over the three weeks the crop was ripe, a family of foragers could have harvested enough grain to meet their needs for a year. The obvious implication was: if wild cereals were so abundant, and so easy to collect, and if the foraging way of life was (on the !Kung-San evidence) so predictable and relatively stress-free, wouldn't foragers just have stayed foragers unless there had been a very good reason to commit to agriculture? As Kent Flannery concluded at the end of a major paper at this time reviewing the state of research on the origins of agriculture (Flannery, 1973), 'since early farming represents a decision to work harder and to eat more "third choice" food, I suspect that people did it because they felt they had to, not because they wanted to'. The wheel had come full circle from Hodder Westropp's thoughts a hundred years earlier on how the change to farming represented our species' advance from a 'state of nature' to our 'natural state', using our high physical organization and progressive intellect to advance our culture.

'PALAEOECONOMY' AND POPULATION PRESSURE

The emerging orthodoxy represented by the London seminar was challenged by Eric Higgs and his research assistant Mike Jarman in a short paper entitled 'The origins of agriculture: a reconsideration' (Higgs and Jarman, 1969). Higgs

came into archaeology in the 1950s after a first career as a sheep farmer in the hills of the English–Welsh border country, so he brought a fresh and personal perspective to the study of prehistoric farmers, including a healthy respect for how hard their lives were likely to have been. In the late 1960s he was appointed to direct a research project at Cambridge University on the Early History of Agriculture funded by the British Academy, with Jarman as his principal research assistant. In the 1969 paper they pointed out what they saw as significant flaws in the theories and methods of current research on the beginnings of farming, arguments they developed further in their introductory paper to a volume of essays publishing the preliminary results of the project in 1972, arguments that were supported in more detail by co-workers in other papers (H. N. Jarman, 1972; Jarman and Wilkinson, 1972).

First of all, they suggested, it was dangerous to assume that modern wild species of domestic plants and animals were automatically the ‘wild progenitors’ of ancient forms. Some island populations of ‘wild’ sheep and goats, for example, were at least as likely to be once-domesticated animals that had escaped at some time in the distant past and gone feral. The modern distributions of wild forms could not be assumed to be the same as past distributions: some could be ‘relict populations’ surviving in marginal situations today that were not representative of past distributions. Had the search for agricultural origins in South-West Asia been a casualty of circular reasoning, therefore? If we expected to find the earliest agriculture only in certain regions, and only looked for it there, we would inevitably prove the hypothesis that it was earliest in these regions.

The second set of criticisms addressed the definition of botanical and zoological criteria as a scientific measure of domestication. Diminution in animal size, for example, was being widely used as an indicator of domestication (it was commonly argued that animals got smaller because early farmers would have selected smaller animals as easier to control, and/or because they were inexperienced at feeding them). However, whilst it was true that the domestic animals at Neolithic sites were generally smaller than the same animals at Mesolithic sites, the latter were also invariably smaller than the same animals in the Pleistocene, and many other species not exploited by humans such as carnivores, very large in the cold periods of the Pleistocene, also got smaller in the Holocene. So although diminution might, for some species, in part reflect domestication, Higgs and Jarman concluded, the process primarily must reflect adaptations to the new climates and habitats of the Holocene. Another criterion of very doubtful value, they suggested, was a high frequency of young animals in a faunal sample (which was commonly assumed to mark a change from hunting to herding) because there were cases in the ethnographic record of hunters selectively killing surplus young male animals, for example

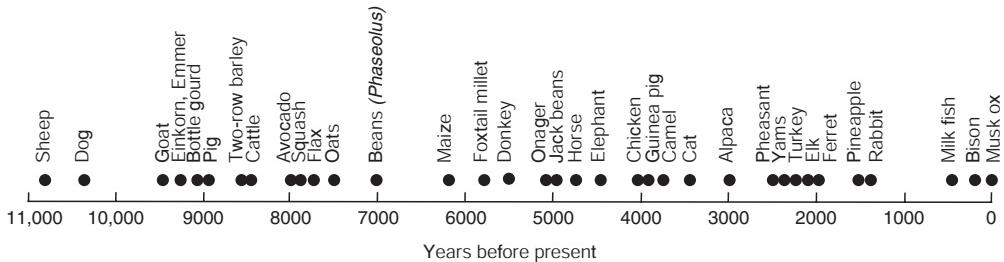


Fig. 1.9. 'Domestication as a continuous process': accepted dates for domestication of a variety of plants and animals over the past 10,000 years (after Higgs and Jarman, 1972: fig. 2)

to help conserve the numbers of breeding females. How, therefore, would the archaeozoologist distinguish the *selective hunting* of sheep and goats from the *herding* of them?

The Harlan experiment clearly showed the potential of harvesting wild cereals, and there was increasing evidence for the intensive exploitation of plants at Natufian sites before any morphological changes had taken place that would meet the archaeobotanist's definition of domestication. The accepted dates for domestication suggested that the process had been going on continuously for at least 10,000 years (Fig. 1.9). Therefore, Higgs and Jarman argued, our approach to the transition from hunting to farming should be to view domestication as a *process* rather than as an *event*. And if morphological changes in animals and plants were indeed showing domestication, such changes must in any case represent a late stage in the process, not its beginning. The transition from hunting to farming needed to be understood in terms of gradually evolving relationships between people, animals, and plants. In short, it was illusory to expect to identify, by searching for the first domesticated corn cob or sheep bone, some precise moment in human history when foragers decided to take their first steps as farmers.

The project proposed improved methodologies for collecting and analysing plant and animal remains (Dennell, 1972; H. N. Jarman, 1972; Jarman *et al.*, 1972; Payne, 1972a, 1972b), and for interpreting such data in terms of the local environmental situation of the site from which they were collected (Higgs and Vita-Finzi, 1972). These theories and methods were put into practice in a series of regional case studies in South-West Asia and Europe published in the three volumes produced by the project, the last after Higgs's death in 1976, a corpus of work often referred to as that of the Cambridge 'palaeoeconomy' school (Higgs, 1972, 1975; Jarman *et al.*, 1982). One of the main thrusts of many of these studies (including my own Ph.D.) was to argue for the intensive

exploitation during the late Pleistocene of a number of species now considered wild: gazelle in South-West Asia (Legge, 1972), red deer in southern Europe (Barker, 1975; Higgs *et al.*, 1967; M. R. Jarman, 1972), and reindeer in northern Europe (Sturdy, 1975). The nature of this exploitation was unclear, the theories proposed varying from selective hunting at one end of the spectrum to herding at the other, with various possibilities in between such as driving (following animals with little interference) or loose herding (letting animals fend for themselves for some times in the year, manipulating their movements and behaviour at others); but the implication was that Holocene domestication was a culmination of processes that were well in train before.

Whilst the 'palaeoeconomists' emphasized the sophistication of late Palaeolithic subsistence, and the complexity of the forager-farmer transition, it remained true that the establishment of mixed-farming systems in the Holocene represented a dramatic intensification in food-procurement systems. How was this to be explained? In general, the explanations proposed were along the lines of the Binford and Flannery models: people responded to environmental change at the Pleistocene-Holocene transition by broadening their subsistence regimes; broad-spectrum subsistence encouraged sedentism; sedentism allowed population growth; and population growth forced people to intensify subsistence. Probably the clearest and most influential development of this thesis was Mark Cohen's *The Food Crisis in Prehistory: Overpopulation and the Origins of Agriculture* (Cohen, 1977). Why had so many societies become farmers at more or less the same time, in the opening millennia of the Holocene? Given the higher work load and, probably, poorer diet associated with farming, the main economic advantage seemed to be that it would have yielded more calories per unit of space than foraging. Cohen therefore argued that agriculture would only have been adopted under conditions when demand for calories was increasing, or when demand was out of balance with supply. As human populations grew in the later Pleistocene, pressure on food supplies was met first by expanding the territorial range of the species but then by subsistence intensification, in each case involving more work and a less palatable diet. By the late Pleistocene, societies all over the world were having to switch from hunting large mammals ('a prized but scarce resource': Cohen, 1977: 280) to broad-spectrum hunting and gathering of more plentiful but less palatable food sources. The climatic amelioration of the Holocene allowed population growth to speed up and soon produced a global food crisis that forced people to start the selective exploitation of a few plant species chosen not because they were particularly palatable but because they were productive and yielded food that was easily stored (Fig. 1.10).

Though rarely so unadulterated as Cohen's thesis, stress models based on combinations of ecological and demographic pressure were common in the

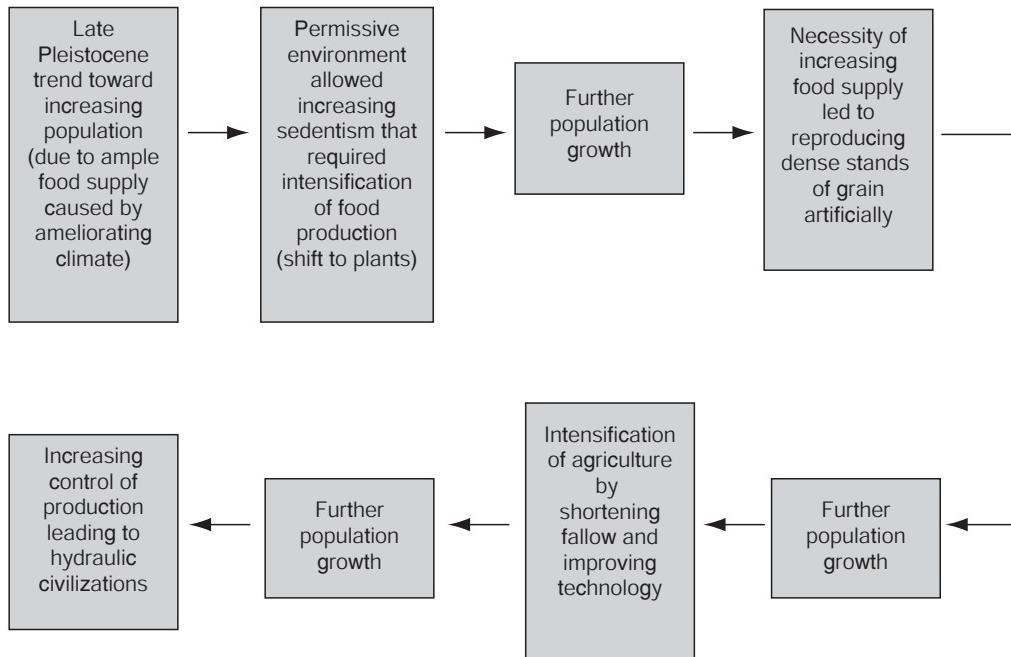


Fig. 1.10. The 'population pressure' hypothesis for the origins of agriculture, as summarized by Redman (1978: fig. 4-4); as he indicates, the model could be extended to include later agricultural intensification underpinning state formation

1970s' literature. Bökonyi (1976), for example, proposed that animal herding began in South-West Asia to increase available animal protein in the context of rising populations. In a collection of papers surveying the evidence for transitions to farming beyond Europe (Megaw, 1977), population-stress models underpinned the discussions of agricultural transitions in South-West Asia (Legge, 1977), Mesoamerica (Bray, 1977), South-East Asia (Glover, 1977), and New Guinea (Allen, 1977).

SOCIAL FORAGERS: AVAILABILITY, CHOICE, RESISTANCE

By the late 1970s doubts were beginning to appear in the literature about 'population pressure-cooker' models of why people became farmers, a critique that was part of wider theoretical developments in archaeological thinking that came to be termed Post-Processual Archaeology (Johnson, 1999). Much of the critique of New Archaeology in general and of 'Cambridge palaeoeconomy' in particular was led by Ian Hodder, himself a Cambridge-based archaeologist

(Hodder, 1982a, 1982b, 1986). Prehistoric societies, he argued, did not operate wholly as *Homo economicus* seeking always to optimize economic returns and to balance inputs with outputs in the most cost-effective way. In our own societies, people take economic decisions for many reasons—need, greed, opportunism, charity, display, status, family loyalty, religious adherence, and so on. The behaviours of modern foragers and farmers are not simply adaptations to a given environment and population level: their economic decision-making is mediated through cultural needs and aspirations. Hodder (1982a) cited the example of two Sudanese agricultural tribes, the Moro and Mesakin, who although practising similar systems of subsistence, had created differing archaeological residues in and around their settlements because of contrasting social relations, gender roles, and ideologies. A typical archaeozoologist of the processual or palaeoeconomy school, he suggested, would have reconstructed identical subsistence patterns for these two societies to his or her satisfaction from studying their animal bones, but would have entirely missed how ideologies structured behaviours:

archaeologists studying the economy through bones appear to assume that their evidence of relative proportions of animals, butchering practices, age distributions, herd control and so on are somehow free of all symbolic content: theirs is supposed to be a practical, rational, scientific world. But meat-eating, the division of the carcass and the dispersal of the bones must always have had a symbolic content behind which there is a conceptual order. Behind the functioning of 'the economy' is a conceptual scheme and meaning. (Hodder, 1982a: 116)

The social context of the transition from foraging to farming was developed further by Barbara Bender in an influential paper entitled 'Gatherer-hunter to farmer: a social perspective' (Bender, 1978). Recent sedentary foragers such as those of the American North-West had most of the characteristics of tribal societies in the classic definition, rather than of the typical hunter-gatherer band: large band sizes, well-defined territories, food storage and control, elaborate ceremonial institutions, and positions of authority, the latter sometimes with even an element of descent from one generation to the next. She pointed out that there was increasing evidence in the Holocene in the period before farming began, in several parts of the world, for more or less sedentary societies living by hunting, fishing (especially), and gathering, whose burials provided indicators of the same sort of social complexity as these recent American North-West foraging societies, such as individuals of apparently high status. From this perspective, she suggested, it was not so surprising that tribal forager societies had developed into tribal agricultural societies—the key social changes had already happened. She did not pose the obvious question challenging this argument: if these foragers were so successful at

sustaining dense and socially complex populations, why did they decide to become farmers? But the critical contribution of the paper was its emphasis on the need, if we were to understand how and why foragers became farmers, to focus not just on subsistence behaviours but also on the social context of foragers' decision-making.

As the debate shifted increasingly to the character of late foraging societies prior to the emergence of farming, and to ideas that some of them might have been developing forms of social behaviour akin to those assumed to be typical of early farmers (Bender, 1981; Rowley-Conwy, 1981a), there was an increasing concern to refine definitions and sharpen the focus on the characteristics of domestication and agriculture: were we trying to understand one process, or several kinds? David Rindos (1980, 1984), for example, proposed a three-stage evolutionary sequence of plant domestication. 'Incidental domestication' occurred when people removed a species from its native habitat and created conditions in which they became an effective, though not the only, agent of dispersal. 'Specialized domestication' would have developed as people began to depend on wild species and consciously to propagate them; he suggested that this would be the stage at which we might expect to find morphological changes starting to take place, if the plant was having to adapt to attract the human agent and permit successful dispersal by humans. 'Agricultural domestication' was when behaviours developed which completely transformed the relations with the plant by controlling its ecology and evolution: behaviours such as tilling and weeding the ground to remove competitors, and selecting seeds for sowing and for storage after harvest.

Ford (1985) proposed for New World agriculture a somewhat similar sequence of increasingly proactive manipulations of plants between foraging and full domestication. His sequence began with 'unintentional tending' arising from the intensive collection of a useful plant, when the ground is trampled and the seeds helped to disperse. Selecting particular seeds or plants as desirable, and avoiding others as less desirable, could have had unexpected genetic consequences: for example, the initial collection of teosinte, the ancestor of maize, might have helped start the process of transforming the plant from one with many small spikes into one with one or two larger cobs. 'Incipient agriculture' was defined by him as the deliberate use of activities to help a plant propagate: tending (weeding, pruning), tilling the ground with a digging stick or hoe, transplanting a plant from one locality to another for convenience or to ensure its availability, sowing—all activities of selection that would be likely to affect the genetic composition of a plant. Domestication was achieved with the appearance of plants that were cultural artefacts, reliant on humans for survival, culminating in deliberate breeding to turn a generalized domesticate into varieties adapted to different environmental circumstances.

In similar vein, in a general review of the domestication process, Harris (1989, 1990) postulated a series of thresholds of increasing energy inputs (Fig. 1.11), beginning with ‘wild plant procurement’ (foraging), involving not simply ‘reactive gathering’ but also burning vegetation and protective tending. The next stage was ‘wild plant-food production’, which involved sowing, weeding, harvesting, storage, and drainage, but minimal tillage; the plants being produced were still phylogenetically wild. With ‘cultivation’ came systematic land clearance and preparation through tillage. The process culminated in ‘agriculture’, the deliberate breeding of phylogenetically transformed (domesticated) crops. The ‘foraging’ stage in this scheme reflected the growing evidence from palynology (in Europe especially, as discussed in Chapter 9, p. 342) that early Holocene foragers were burning vegetation, and the ‘wild plant-food production’ stage the emerging evidence at Abu Hureyra in Syria that Natufian people were exploiting a wide range of wild plants using many of the techniques normally correlated with agriculture, and sustaining sedentary settlement in the process (Hillman, 1975; Moore, 1982; and see Chapter 4, pp. 121–2).

In a 1986 review on the origins of agriculture in the New World, Barbara Stark identified three main types of models—‘push’, ‘pull’, and ‘social’—which are an apt description of the development of theories regarding the process in other parts of the world (Fig. 1.12). ‘Push’ models were the kind of theories like those of Binford, Flannery, and Cohen described earlier, which proposed that people were propelled into farming by some kind of stress, such as environmental change or population pressure, the latter often seen as the inevitable outcome of sedentism. ‘Pull’ models were those that suggested that, when foragers started to rely on particular plants and/or animals, their exploitation might in some circumstances change existing patterns of behaviour, drawing them unsuspecting into new relations of dependency. An example of the latter would be Flannery’s (1968) model for Mesoamerica, that small genetic changes to plants such as beans and maize made them more attractive to foragers, who therefore spent more time in collecting them, changing their seasonal schedules of hunting and gathering as a result, encouraging them to extract more food from the plants by cultivation to make up for the other resources they were losing. ‘Social’ models envisaged hunter-gatherers changing to farming within the context of changing social structures and, in particular, increasing social obligations, a development of the kind of Barbara Bender’s ideas about complex foragers. Hayden (1992, 1995) proposed, for example, that ambitious individuals in complex hunter-gatherer societies would have been under pressure to maintain prestige amongst their followers and in those circumstances might have been attracted to farming either as a way of securing exotic and so high-status foods (even though they eventually

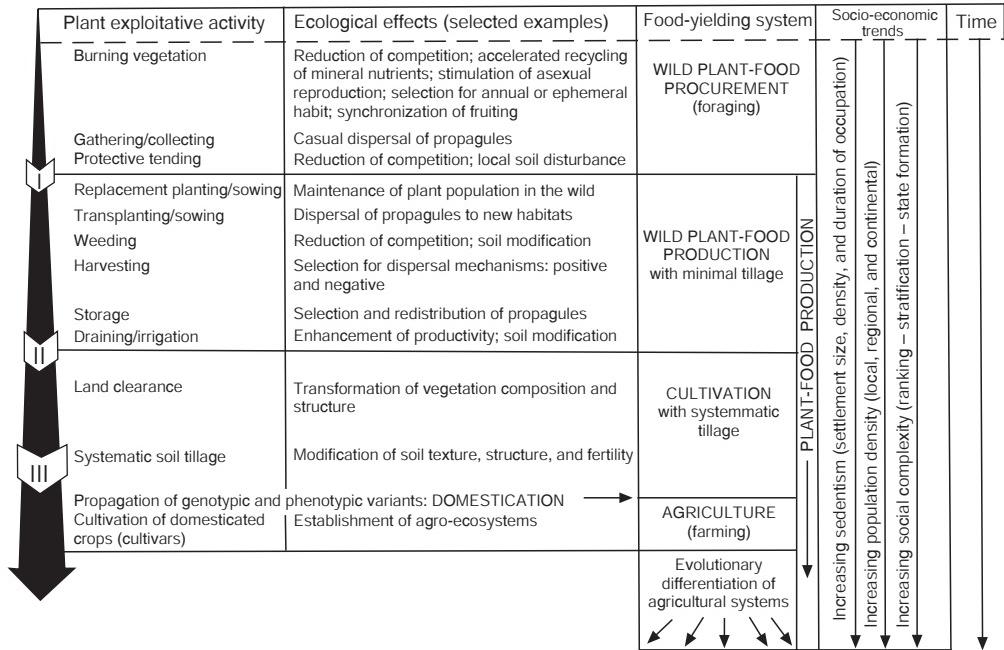


Fig. 1.11. (above)
Evolutionary sequence
describing the
development of farming
and domestication from
foraging; each of the
stages on the left
represents a significant
increase in energy
investment (after Harris,
1989: fig. 1.1)

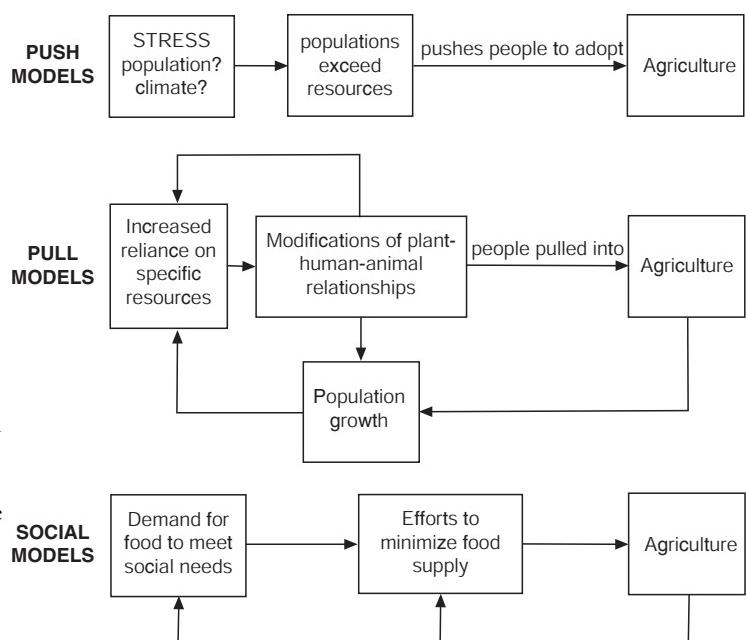


Fig. 1.12. (right)
Schematic representation
of the general arguments
underlying 'push', 'pull',
and 'social' models of the
transition to agriculture
(after Bogucki, 1999a:
fig. 21.4, adapted from
Stark, 1986)

became staples), or because it allowed them to increase food surpluses to sustain their competitive activities.

DOMESTICATING THE MIND?

There is no doubt that there are profound differences between the ‘world-views’ of foragers and non-industrial farmers today, as discussed in the next chapter. Modern interpretations of the archaeological record suggest that, without reading the present simplistically back into the past, prehistoric foragers and farmers are likely to have been somewhat similarly differentiated in how they viewed the world and their sense of place within it. Hence much of the emphasis of recent theoretical discussions has shifted from the social choices involved in foragers deciding to become farmers to the cognitive changes involved in the transformation. Prehistoric foragers probably saw themselves as part of the cosmos, along with the animals they hunted and the plants they gathered. It is argued that, once people became farmers, their cognitive world had to shift profoundly from a sense of belonging to and being part of the wild to ‘acculturating’ it as it became something to control and appropriate rather than be part of. Ancestors, and their final resting places, took on new significance as an important means by which early farmers signified this new relationship to land:

The Neolithic way of life was based above all on a set of beliefs, values and ideals, about the place of people in the scheme of things, about descent, origins and time, and about relations between people. It involved the conceptualization of a universe peopled by spirits and ancestors as well as by the living. From spirits, ancestors and other beings came a sense of the sacred, and this, rather than anything more secular, guided people’s values and beliefs. (Whittle, 1996: 355)

The nature of Neolithic ideology and its role in structuring early agricultural societies have been a major focus of most recent studies of early farming societies in north-west Europe (R. Bradley, 1993, 1998, 2000; Edmonds, 1999; Hodder, 1990; J. Thomas, 1991, 1999; Thorpe, 1996; Tilley, 1996; Whittle, 1996). There has been less consideration of the origins of such ideologies. Simply put, were changing ideologies a cause or a result of foragers becoming farmers? Did the transformed world-views of Neolithic societies encapsulated in Alasdair Whittle’s quotation above have their origins in the behaviours of complex forager societies, with cognitive transformations amongst the latter being a significant stimulus of behavioural changes culminating in farming? Or were new ideologies the inevitable result of the profound changes in mental maps involved in becoming a farmer?

One of the most provocative studies on this theme was Ian Hodder's 1990 study of the beginnings of farming in South-West Asia and Europe, significantly entitled *The Domestication of Europe*, in which he inclined to the first view, of ideology as the driver of subsistence change. He argued that agriculture could be viewed as the culmination of social and symbolic processes that had been developing through the Palaeolithic, relating to how people saw themselves with respect to the natural world. Late Pleistocene hunter-gatherers, he suggested, were already acquiring social and cultural prestige through the separation and control of nature, the 'culturing of the wild'. Adaptations by Holocene hunter-gatherers to changing environments could also be understood as a set of social strategies based on the metaphor of the cultural control of the wild. Forest clearances for hunting were but a step away from clearances for agriculture, and in South-West Asia, he concluded, the idea of controlling the wild was simply extended to certain plants and animals, leading inevitably to agriculture. Separating certain plants and animals from the wild, though, led to new interdependencies between people and domesticates, and new behaviours: the prestige of the cultural order shifted from intervention in the wild (the *agrios*) to a new domain, the agricultural settlement, creating a set of concepts relating to the house and home (the *domus*) that could be found throughout Neolithic societies in South-West Asia and Europe. Jacques Cauvin, whose writings were an important influence on Hodder's thinking, has likewise argued that changes in ideology amongst South-West Asian foragers preceded and stimulated their eventual commitment to agriculture, rather than the other way round (Cauvin, 2000).

CONCLUSION

Archaeologists' ideas about why foragers became farmers have changed repeatedly since the confident pronouncements of the Victorians. The changing debate described in this chapter can perhaps be caricatured as having progressed through the following major perspectives: (1) the advantages of farming were obvious, it just needed time for people to see them as the next rung on their Ladder of Progress; (2) the advantages were obvious, it just needed Holocene environmental change to concentrate foragers' minds; (3) the disadvantages were obvious, foragers only became farmers when the choice was either to become farmers or to starve; (4) foragers were well on the road to becoming farmers in the late Pleistocene, so it just needed the stimulus of Holocene environmental change; (5) foragers found they were becoming farmers despite themselves because of how they reacted to Holocene environmental change, with no going back; (6) foragers could see there were

few advantages in farming, and successfully resisted for a long time; (7) foragers (or rather a few ambitious individual foragers) could see that there were advantages in having more food, or strange exotic foods, for maintaining and enhancing status; (8) foragers' culture had already moved from being part of the wild to controlling the wild, so it was just 'one small symbolic step' to fencing some of it off.

As we have seen, these changing theoretical perspectives on the origins of agriculture have been part and parcel of wider theoretical developments within archaeology: from Victorian theories of stages of human development, to Childe's concept of the primacy of the 'prehistoric culture', to the Processualists' concerns with systemic change and the dominance of economic decision-making, to the Post-Processualists' focus on structure and agency (the roles of individual 'actors'). Nevertheless, in this as in other areas of archaeological inquiry, the thrust of mainstream research has not developed absolutely hand in hand with theoretical shifts: many of the ideas about why prehistoric foragers became farmers that were first expounded by archaeologists 100, 50, 20, or ten years ago still provide the dominant theoretical frameworks of the global community of archaeologists and scholars in related disciplines working on the problem today. Some of these should have passed their 'sell-by date' some time ago, but others continue to stimulate effective research even though they may not sit comfortably with the most recent theoretical discussions. Overall, the development of theoretical frameworks in relation to the origins of agriculture has probably been shaped most of all by archaeologists' changing awareness of the complexity of forager and farmer decision-making. Having said that, one of the most surprising aspects of the history of the debate has been how often sophisticated arguments have continued to be structured implicitly around a notion of an inevitable progression (and indeed progress) from foraging to farming as an unstoppable one-way historical process, Westropp's Stages of Development of Man by another name.

Whilst changing theoretical perspectives have of course been affected by new discoveries and new techniques, it is noteworthy how, in many regions of the world, they have been able to thrive without the inconvenience of being tested by significant new data! In South-West Asia, for example, the political instability of the region has meant that in many parts of it very little new data have been produced by fieldwork from the early 1970s onwards, so that excavations of one or two new sites, like Abu Hureyra, became the focus for exhaustive interpretation and reinterpretation. Research in Mesoamerica and South America has often been affected by political instabilities in much the same way. Archaeological fieldwork in Africa over the past four decades has also been extremely patchy, extensive in some regions and entirely absent

from others, because of armed conflicts and political unrest, and of course the same situation applied in mainland South-East Asia during the Vietnam war and its aftermath. Little work by Chinese archaeologists was known to outside scholarship through the 1960s and 1970s, the Cultural Revolution put an effective stop to Chinese academic research, and it was not until well afterwards that field investigations were resumed by Chinese archaeologists and their collaborators.

Nevertheless, along with the changing theoretical debates summarized in this chapter, over the past 15–20 years there *has* been relevant new fieldwork in all major regions of the world, augmented by the results of dramatic advances in archaeological science and other disciplines such as molecular genetics. The combination of new theories and new data has transformed understanding of the nature of forager–farmer transitions—what happened, when, and how—in every region of the globe. To use these findings to address the ‘why’ questions, though, we have to begin with modern forager societies and what is now understood about the social and economic options available to them, as a means—however fraught with difficulty—of trying to understand the nature of foraging societies in prehistory. These topics are the subject of the next chapter.

2

Understanding Foragers

INTRODUCTION

Hunter-gatherer or forager societies, as the names imply, have been defined first and foremost by their mode of subsistence: ‘hunting of wild animals, gathering of wild plants, and fishing, with no domestication of plants, and no domesticated animals except the dog’ (Lee and Daly, 1999: 3). Another recent survey develops this defining characteristic in the following terms: ‘the *absence of direct human control* over the reproduction of exploited species, and little or no control over other aspects of population ecology such as the behaviour and distribution of food resources. In essence, hunter-gatherers exercise no deliberate alteration of the *gene pool* of exploited resources’ (Panter-Brick *et al.*, 2001b: 2, their italics). In addition to this primary characteristic of ‘not being farmers’, there are or have been two other very common features amongst recent and contemporary forager societies, as Lee and DeVore (1968b: 11) commented in their opening essay to the seminal *Man the Hunter* volume: ‘(1) they live in small groups, and (2) they move around a lot’.

At the end of the Pleistocene, forager societies peopled most regions of the world, at most latitudes. By the middle of the second millennium AD, foragers still occupied a third of the globe including all of Australia and most of North America, and large tracts of South America, Africa, North, and North-East Asia. Yet in recent centuries foragers have ‘retreated precipitously in the face of the steamroller of modernity’ (Lee and Daly, 1999: 1), occupying only those areas where farmers simply cannot go, or where farming is so marginal as to be uneconomic (Fig. 2.1). Many societies frequently cited in archaeological textbooks as examples of forager societies today, like the !Kung-San of the Kalahari, in fact also practise cultivation or herding on a small scale, and others depend heavily on trade with neighbouring farmers for staple foods. It is extremely difficult to translate foragers’ behaviour as recorded today or in the recent past into theories of general applicability to the world’s prehistoric foraging population prior to farming. The task is all the more complicated by the remoteness of the everyday lives of foragers (present and past) from western Europeans, a remoteness that has given rise to two enduring currents



Fig. 2.1. The distribution of forager societies today (after Lee and Daly, 1999: map 1)

in European philosophical thinking about such societies: that they are alien savages on the one hand, or innocents close to the state of nature on the other (Barnard, 1999). The first was epitomized by Thomas Hobbes's famous description in 1651 of the life of the warlike savage as 'solitary, poore, nasty, brutish, and short', the second by Jean-Jacques Rousseau's vision in 1755 of timid foragers living peaceful, healthy, and contented lives deep in the forest (Hobbes, 1973; Rousseau, 1973). Both perspectives related primarily to the political agendas of the writers, as has much popular commentary on foraging peoples ever since.

Of course foragers today are part of the same global society as the rest of us, and in no sense can be regarded as living embodiments of any kind of prehistoric lifestyle, as 'unmediated visions of the past' (Lee and Daly, 1999: 11). In many respects they have to be understood as 'a mode of subsistence that has developed contemporaneously with intensive cultivation and pastoralism ... and relies on social strategies of comparable complexity' (Layton *et al.*, 1991: 263). Indeed, a revisionist view of some forager societies is that, far from being the last exponents of an age-old lifestyle, they should be regarded more as victims of colonialism, with many of the key characteristics of their way of life—their mobility, material poverty, food sharing, and so on—being survival responses to existing on the fringes of powerful states, at the bottom of society (Schrire, 1984; Wilmsen, 1989; Wilmsen and Denbow, 1990). Some forager societies may also be relatively recent: for example one view of the Penan (or Punan) foragers in the tropical rainforests of Borneo is that they may originally have been farmers who turned to foraging in the medieval period in response to Chinese demands for highly prized forest products such as hornbill feathers and birds' nests (Beavitt, 1992; Hoffman, 1984). However, although there is today, and has been in the recent past, considerable variability in forager societies (Kelly, 1995; Kent, 1996), much more striking are the similarities that can be discerned in the economic, organizational, and ideational or cognitive solutions that most of them have developed for living as they do. For all the difficulties of using ethnographic material, the behaviours of recent and present-day foragers remain an invaluable resource for helping us reflect on the likely characteristics of forager behaviours before farming.

TRADITIONAL DEFINITIONS OF FORAGERS AND FARMERS

For Gordon Childe, the primary characteristic of prehistoric foragers was their necessity to stay mobile in the pursuit of their food. This drastically curtailed their ability to multiply, and also the amount of leisure that they

had. They did not generally store food or build substantial houses; they could own little, because everything had to be carried with them when they moved. On the other hand, their flint and bone tools were extremely sophisticated, and there were many indications that these societies could have a rich spiritual life and well-developed aesthetic feelings. They must also have had a profound understanding of the natural world they inhabited, of the habits of the game they hunted, of the uses of different plants for food, dyes, potions, and so on. Hunting large game must surely have involved the cooperation of a group larger than the natural family. Presumably these groups were self-contained, and self-sufficient. On the analogy with recent foraging societies, he suggested (1936, 1942), hunting and fishing territories were probably communally owned, with men involved mainly in hunting and women in gathering, and the resulting food shared within the community. Presumably these societies were fundamentally egalitarian, though perhaps people like the Magdalenian reindeer-hunters (the best-known creators of Upper Palaeolithic cave art, at sites such as Altamira in Spain and Lascaux in France) had specialized magicians. Childe also noted that in recent foraging societies particular individuals such as older males might enjoy authority and prestige, and that a few societies such as those of coastal North-West America, where rich fish supplies sustained sedentary villages, had complex social structures characterized by hereditary chiefs, wealth differences, and warfare. However, they were the exception, not the rule.

Early farming societies, in contrast, had 'a new aggressive attitude to the environment' (Childe, 1942: 49). This was evidenced most of all in their systems of plant and animal husbandry, but was also inherent in other characteristics of these societies: in the firing of clay to make pottery; the spinning of plant and animal fibres to make cloth; the selection of different types of stones for making quern-stones, sickles, polished axes and adzes; and the use of materials such as mud, reeds, timber, stone, and withies to make houses. There was probably a clear division of labour between the sexes, men herding and hunting and women cultivating as well as undertaking tasks such as potting and weaving. People lived in settled villages, though they moved on every few years in search of new land if and when agricultural yields fell. They were able to plan ahead, storing food in granaries. The basic social unit was the household, villages consisting of clusters of households. Though the entire village community might cooperate for certain major tasks, each household probably aimed to be more or less self-sufficient in terms of growing its own food and obtaining the local resources it needed of stone, bone, wood, and clay. In practice, though, this was not possible, so a normal feature of early farming societies was trade; the evidence mainly consisted of luxury goods

that survive in the archaeological record, but exchange in perishable everyday items was probably also important.

Childe's understanding of the differences between typical foraging and agricultural societies was remarkably similar to the classifications developed later by American anthropologists that, though regarded as overly simplistic and neo-evolutionary today, still provide an important framework of reference (Sahlins, 1972; Service, 1966). Hunter-gatherers were classified in these schemes as *band* societies, classically defined as mobile, territorial, egalitarian, and fluid in band membership. Small-scale agriculturist societies were characterized as *tribal*: usually sedentary, organized as extended families in separate ('segmented') kin groups, with loosely developed vertical differentiation (that is, differences according to social status), and with most production organized at the household level—what Sahlins called the Domestic Mode of Production. More complex agricultural societies with greater social and economic differentiation (with systems of redistribution, and exchange of prestige goods, for example) were characterized as *chiefdoms*.

The key elements of the productive system for small-scale agriculturalists are land, labour, and surplus. 'The pattern of social relations in agricultural formations uses the product of the land to support and reproduce institutions and roles which are defined by the fact of ownership, inheritance, and the transmission of property between generations' (Gamble, 1986: 29). Characteristic of all farming cycles is that there are activities requiring intensive labour within a restricted period of time, such as land clearance, planting, weeding, and harvesting. In small-scale farming these labour bottlenecks cannot be overcome by expensive technology, as in mechanized agriculture, so the amount of labour available is a major limiting factor on production. Moreover, given the risks and uncertainties of farming, and the small scale at which an individual household operates as a productive unit, subsistence farmers invariably have to help each other out with between-household exchanges of food, equipment, and labour. In the ethnographic record such exchanges take 'a variety of cultural guises ranging from simple sharing to the provision of feasts in formal social contexts, and from hospitality in the context of "casual" visiting by needy neighbours or relatives to more or less blatant exchanges of food in return for goods and services' (Halstead, 1989: 73). Sahlins (1972) called such networks of obligation and mutual support 'balanced reciprocity', in which a gift anticipates an equivalent return; he contrasted this with the 'negative reciprocity' of more hierarchical agricultural societies characterized by differential access to land, labour, and surplus, whereby something is obtained for nothing in relationships between unequals.

THE FORAGING WAY

The extent to which foragers hunt, fish, and/or gather depends first of all on the latitude at which they live. As a general rule, productivity in terrestrial ecosystems decreases with distance from the equator, along with the length of the growing season. A food-rich environment like rainforest has high plant productivity and a rich diversity of habitats from the forest floor to the upper canopy. An arctic tundra, by contrast, has low plant productivity and few animal species. Decreasing productivity in vegetation means fewer plants for human consumption, so foragers living further from the equator need to rely more on animals to convert the available plants to energy. Marine resources also differ markedly with ocean productivity. Generally, therefore, tropical and desert foragers rely heavily on plant gathering, foragers in temperate latitudes rely more on hunting and fishing than gathering, and at extreme latitudes only hunting and fishing may be possible. At the regional scale, of course, there is rarely a simple predictive relationship between latitude, productivity, and subsistence strategy. For example, hunting will be particularly productive when there are aggregations or herds rather than small dispersed populations of animals: large clusters of big animals on a tundra or savannah are clearly more of a hunting proposition than, say, lots of small animals in ones or twos in a thick forest. An ocean may be rich in mammals and fish, but people have to have a fishing technology capable of catching them.

Foragers are invariably *territorial*: a particular social group or band inhabits the same tract of country year after year. In general, the greater the abundance and security of food supplies, the smaller the territory needed for a given group of foragers, and the higher the population densities (Rogers, 1969; Tindale, 1974; Fig. 2.2). In some societies the bands defend the area they exploit, whereas in others access to resources is less controlled and band territories overlap. As food sources are invariably seasonal rather than equally available throughout the year, and also occur in clumps or patches rather than being equally distributed across the territory, most foragers are *mobile*, moving from food source to food source within their annual territory. However, they are not 'nomadic' in the sense of moving about in an unplanned way. Movements are carefully scheduled or structured to take advantage of seasonal fluctuations in the availability of food sources.

An important distinction in mobility patterns was pointed out by Binford (1980), between what he termed *foraging* and *collecting* systems (Fig. 2.3). Foragers use a series of residential or base camps located to have daily access to favoured food sources. People go out from the campsite on a daily basis as individuals or in groups to hunt or gather, the whole group moving from

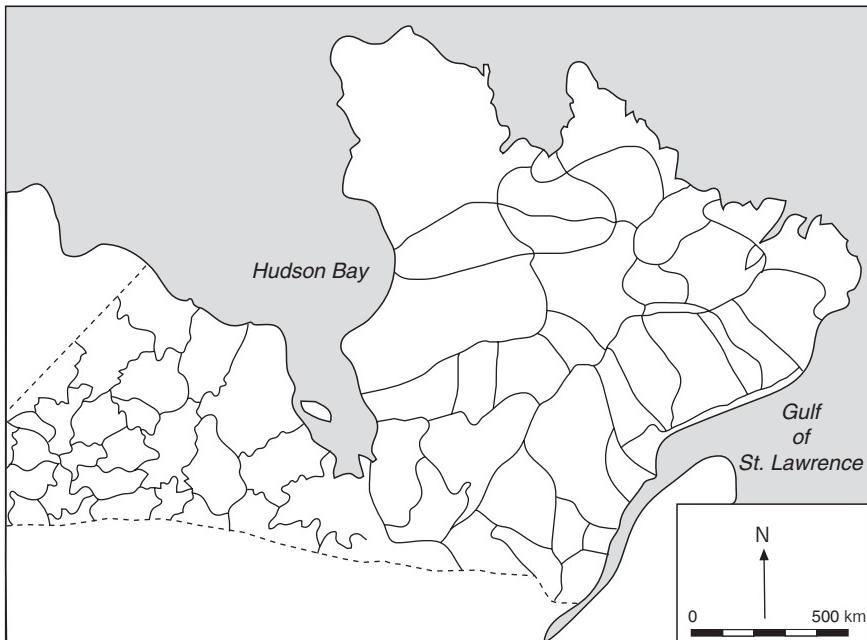


Fig. 2.2. Traditional hunting territories in the eastern Canadian sub-Arctic: territories decrease in size in the west, where game densities are highest; the dotted lines show the area that was mapped in the study, approximately the modern states of Ontario, Quebec, and Newfoundland (from Gamble, 1986: fig. 2.5, after Rogers, 1969)

one camp to the next as the resources around the former start to diminish. Foragers of this kind are typical of plant-rich environments, such as the !Kung-San of the Kalahari (Lee, 1968, 1972). Collectors are typical of extreme-latitude environments subject to dramatic fluctuations in the abundance of food resources in time and space. They have residential or base camps for the main population, but hunting parties set up a variety of field camps, observation stations, and intercept hunting camps at a distance to monitor game movements, hunt and kill the game. They cache the meat around the landscape and bring food back to the main camp as and when required. An example of these was the Nunamiut reindeer-hunters of Alaska (Binford, 1978). Careful planning (a 'logistic strategy' in Binford's phrase) is required by collectors to solve their formidable logistical problems. They generally need to use more complex technologies for acquiring their food than foragers in richer environments (Torrence, 1983, 2001). Another common trait amongst them is the frequency of food processing (such as drying) and storage systems to cope with the fact that resources are not only scarce but also only available in certain

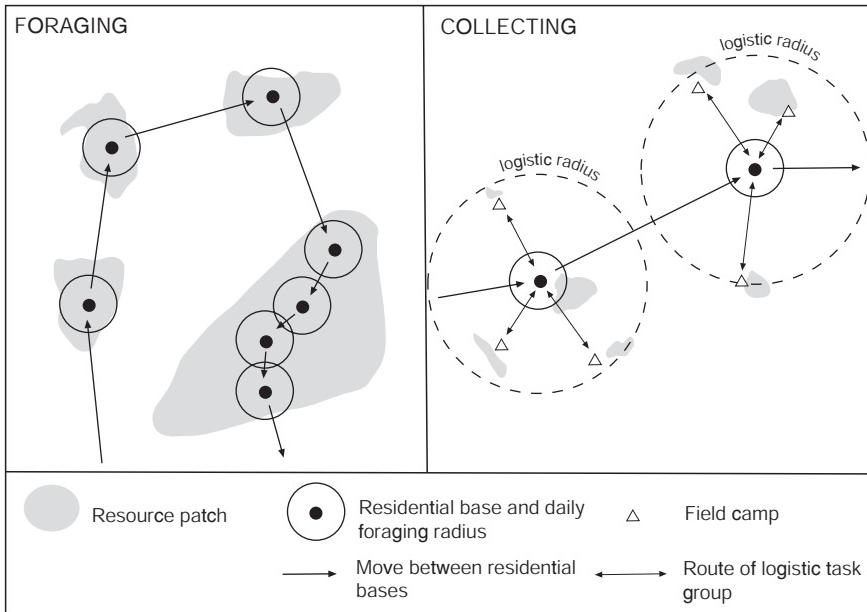


Fig. 2.3. Schematic maps contrasting foragers (*left*) with collectors (*right*), following the arguments of Binford (1980); each shows the same proportion of hypothetical annual rounds, so that foragers' residential bases are occupied for shorter periods than those of collectors (after Rowley-Conwy, 2001: fig. 3.1)

seasons (Fig. 2.4). Woodburn (1980, 1982) drew very similar distinctions in classifying foraging strategies as either 'immediate return' (typical of tropical and desert environments), in which food was consumed on the spot, and 'delayed return' (typical of northern latitudes), in which food could be stored for months or even years.

The ethnographic record also includes instances of societies who were entirely dependent on wild foods but where resources were such that semi-sedentary settlement was possible. The main region where such societies are attested is the north-west coast of North America, where peoples such as the Kwakiutl developed subsistence systems based especially on a mix of coastal fishing, sea mammal hunting, and inland salmon fishing (Boas, 1921). The Kwakiutl practised logistical foraging, living in plank houses in the summer and also building temporary structures at seasonal fishing sites. Similarly in the central Canadian Arctic, the hunting of prolific whale populations allowed Thule Eskimo around AD 1000 to live in large villages of semi-subterranean houses (Savelle, 1987).

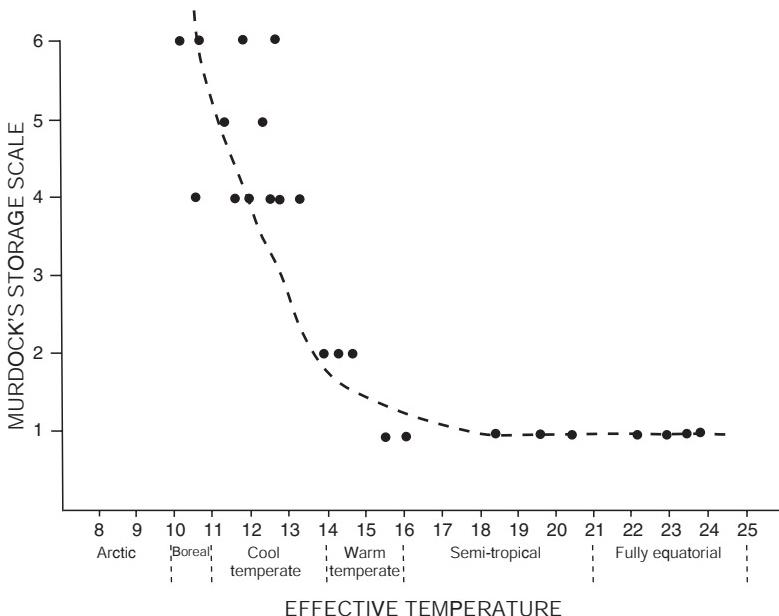


Fig. 2.4. The role of storage amongst hunter-gatherer societies in food-poor cool environments and food-rich warm environments; the vertical scale ('Murdock's storage scale') shows the degree of dependence on storage, the horizontal scale shows effective temperature (after Gamble, 1986: fig. 2.2, following Binford, 1980)

Over the past twenty years, many anthropologists and archaeologists have attempted to understand forager subsistence, present and past, in terms of a body of theory derived ultimately from behavioural ecology and evolutionary biology (Bettinger, 1979; Winterhalder, 2001; Winterhalder and Smith, 1981). The basis of this 'optimal foraging theory' is the assumption that the economic actions of foragers will be sensible and effective in context, seeking to maximize rates of energy return and to minimize risk. Foragers are faced with a range of opportunities and constraints on a daily basis. Different resources provide different amounts of energy, but their acquisition also takes energy, and foraging time is finite. They therefore have to weigh up competing demands relating especially to the density and distribution of resource 'patches' (whether patches of vegetation, or groups of animals, or individual animals) and the time it will take to locate, pursue (if an animal), and process a resource and, if desired, get it back to camp (Fig. 2.5).

The foraging opportunities in a 'fine-grained' landscape with a homogeneous distribution of resource patches will clearly be very different from those in a 'coarse-grained' or heterogeneous landscape with diverse patch

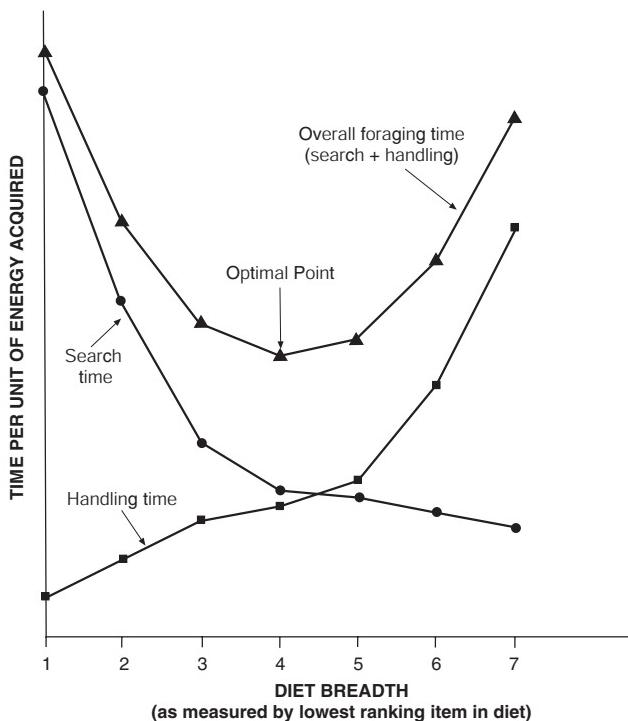


Fig. 2.5. An example of optimal foraging theory: modelling decision-making about diet breadth; items of diet are ranked according to net energetic intake per unit of handling time, so handling time increases with increasing diet breadth; items are added to the diet so long as the decrease in search time is greater than the increase in handling time; in this example, Items 1–4 are considered within the optimal diet, whereas including Item 5 would be considered sub-optimal (after Bettinger, 1979)

distribution and composition. A typical choice might be whether to collect seeds that were perhaps abundant but yielding little energy for the time and effort expended, or to concentrate on hunting game, an activity requiring greater effort and with more risk of failure, but with potentially more attractive rewards. Collecting the seeds might be worthwhile if they are near to camp, because whole bushes can be brought back for processing at leisure, but not when it takes a long time to travel to them, collect them, and then strip the seeds from the plants for efficient transport back to camp. Alongside questions of relative efficiency, foragers also have to take into account the relative risks in pursuing particular foods. Risks can be mitigated by a variety of behaviours including storing and/or sharing food, coming together and splitting up from season to season, working together in collaborative hunts, using technologies effectively (for example using dogs, traps, poisons, surrounds, hides, and so on to increase success rates in hunting), and sharing information within and between groups so that resource patches can be located faster, or sampled more quickly, or not abandoned too soon.

The assumptions underpinning optimal foraging theory, of maximizing efficiency and minimizing risk, have been investigated in detailed studies of

the subsistence strategies of modern foraging groups in very different environments, including the rainforests of Paraguay, Ecuador, and Venezuela in South America (Hames and Vickers, 1982; Hawkes *et al.*, 1982; Hurtado and Hill, 1990), the rainforests of the Congo (R. Bailey, 1991; Hewlett, 1991), the desert interior and tropical coastal islands of Australia (Bird and Bleige-Bird, 1997; O'Connell and Hawkes, 1981), and the northern forests of Canada (Winterhalder, 1981). In these studies, resources were ranked in terms of their potential net energetic return (net, in relation to acquisition costs), and the actual behaviour of the foragers then compared with the 'ideal' subsistence strategies suggested by optimal foraging theory. In general, the actual behaviour of the foragers closely fitted the predictions of the foraging model proposed for them. Different groups of South American rainforest foragers, for example, consistently favoured what the foraging model predicted would be high-ranked resources for them (Table 2.1), ignoring lower-ranked resources regardless of their abundance. More middle- and lower-ranked resources were exploited nearer to camp, and only high-ranked resources at a distance. If search times for high-ranked resources increased, then more resources of lower rank were collected, but the high-ranked resources were never ignored. Similar principles operated in the desert foraging systems of the Alayawara in Australia and the hunting strategies of the Cree in Canada. The robustness of the foraging models compared with the actual behaviour of the modern

Table 2.1. Total energetic return rates of Aché foragers in eastern Paraguay over 61 foraging days

Resource	Total amounts collected (kg)	Calories per kg	Calories per handling hour	Ranking of resources
Collared peccary	232	1,950	65,000	1
Deer	300	819	27,300	1
Paca	307	1,950	6,964	2
Coati	351	1,950	6,964	2
Armadillo	386	1,950	5,909	3
Snake	10	1,000	5,882	3
Oranges	1,283	355	5,071	4
Bird	35	1,240	4,769	5
Honey	57	3,037	3,266	6
White-lipped peccary	457	1,950	2,746	7
Palm larvae	43	3,124	2,367	8
Fish	189	975	2,120	9
Palm heart	171	595	1,526	10
Monkey	533	1,300	1,215	11
Palm fibre	1,377	120	1,200	11
Palm fruit	249	350	946	12

Source: Hawkes *et al.*, 1982: table 3.

foragers has encouraged archaeologists to examine their own data in the light of similar predictive models (for example: A. J. Anderson, 1981; Barton, 2001; Bonzani, 1997; Broughton, 2002; Elston and Zeanah, 2002; Jochim, 1998; Metcalfe and Barlow, 1992; Nagaoka, 2002).

In the Great Basin of North America, for example, recent foragers relied heavily on the nuts of the pinyon pine (*Pinus monophylla*), but archaeological sites produced both pinyon pine and pickleweed (*Allenrolfea occidentalis*) (Metcalfe and Barlow, 1992). There were marked differences in the proportions of the two food remains at particular archaeological sites, and in the kind of waste products from processing them. It was concluded that pickleweed, which needed much more handling time, was only being processed when patches of it were near camp. When pine patches were near camp, whole kernels were taken back for processing, but at an intermediate distance pine kernels were partially processed where they were located, and nuts in pine stands located at a distance were fully processed before being brought back. In another study of Great Basin archaeology, simulation indicated that Pre-Archaic foragers had a narrower diet breadth than later foragers, and that the archaeological data also reflected different foraging strategies of men and women (Elston and Zeanah, 2002).

Optimal foraging modelling has been criticized as being overly deterministic and ignoring the complexity of foragers' 'world-views' (Ingold, 1992; and see below). However, its importance is not that it tries to predict in a formulaic or environmentally deterministic manner what past foragers in a particular region at a particular time *will* or *must* have done. Rather, it allows archaeologists to compare their data (sites in particular locations, and particular assemblages of tools and food remains) with an independently established foraging model (Table 2.2) and then reflect on the similarities or divergences that emerge from the comparison. Relying over-heavily on modern or recent ethnographies to explain archaeological data carries its own dangers of imposing the present on the past, and being unable

Table 2.2. General expectations of foragers' resource use of high- and low-ranked food items

High-ranked resources	Low-ranked resources
Suitable for transport over large distances	Not suitable for transport over large distances
Field processing likely	Minimum field processing likely
Influence the location of logistic camps	Influence the location of residential camps
May be underrepresented in site remains in terms of relative importance of contribution to diet	May be overrepresented in site remains in terms of relative importance of contribution to diet

to identify subsistence behaviours that are different from the ethnographic models.

SOCIAL STRUCTURES

Forager societies, as we have seen, have been classically defined as band societies: small-scale communities of 15–50 people related by kinship. Band societies are generally characterized by ‘flat’ or egalitarian rather than hierarchical social structures, such leadership as there is being provided by particularly experienced or skilful individuals recognized for their prowess and leading by example, rather than by fixed leaders such as headmen or chiefs. ‘Animals are hunted, plants are gathered, and the immediate surplus distributed to close kin and members present in the camp. These gifts are made in full expectation of their return at a later date. Prestige and status may go to the habitually successful hunter but this social position dies with him—that is, his children do not inherit his status’ (Gamble, 1986: 29). Social relations are embedded in kinship ties, and are invariably face-to-face. Lewis Henry Morgan (1881: 63–78) famously described the give-and-take pooling of effort and resources typical of the forager band as ‘communism in living’, leading Marx and Engels to characterize the original state of human society as ‘primitive communism’ (Lee, 1988). Service (1966) redefined forager social relations as a system whereby familial relations that in agricultural societies are internal to an individual household were extended across the entire community in loose networks of social obligations, networks which Sahlin (1972) termed ‘generalized reciprocity’. In contrast with these ideas, Ingold (1999: 401) argues that the basis of typical forager society is neither Service’s ‘single household’ nor an aggregate of nuclear family units but rather ‘two relatively autonomous domains of production and consumption, respectively male and female. What we might recognize as “families” are then constituted at the multiple points of contact between these domains, through relations of exchange involving food and sex.’

The mobility that is so essential to subsistence underpins social structure as well. Social boundaries are generally fluid, with women commonly marrying into other bands (‘patrilocality’) as part of complex networks of social alliances. Both men and women may also move from one band to another to resolve internal disputes. Thus the composition of a particular band may change repeatedly, even though the band itself may represent a relatively enduring entity within the landscape. Another common feature of forager mobility is the process of concentrating into larger aggregations and dispersing into smaller groupings in particular seasons. Thus several bands may come together for a short period of time to make a community of several

hundred people, who spend the rest of the year in individual bands or smaller sub-groups. This process is invariably in response to shifting distributions and abundances of food sources, but it provides critical opportunities for social exchange. The various levels of social mobility, from individual life histories to seasonal band concentrations, all help to create viable breeding networks from dispersed bands of foragers, networks which Wobst (1974, 1976) calculated need to be in excess of about 500 people to make a healthy gene pool. They also provide an effective mechanism for distributing across the landscape material goods and more abstract aspects of shared culture such as ritual behaviours and the accurate information about food supply which foragers need for their survival.

Normally associated with such patterns of mobility are concepts of shared property. Movable property is usually owned by individuals, but if land is owned (and this concept is alien to many forager societies, as described below), it is owned collectively by a kin group. In some societies the whole group has unrestricted access to all the land within the group's territory, in others access may be more restricted to kin groups, but in such cases marriage alliances and rules of reciprocal access tend to achieve much the same result.

Lee's (1968) discussion of Kalahari !Kung-San subsistence in the *Man the Hunter* seminar was a seminal moment in forager studies (Chapter 1, p. 28). For the first time he depicted the forager lifestyle as an ordered schedule of food collecting that took remarkably little time and effort compared with the life of neighbouring subsistence farmers, with a range of contingency foods available if the supply of more desirable foods failed. The !Kung-San gave rise to Marshall Sahlins's famous reflection on past foraging societies at the same seminar that:

This was, when you come to think of it, the original affluent society. By common understanding an affluent society is one in which all the people's wants are easily satisfied... [but] wants are 'easily satisfied' either by producing much or desiring little, and there are, accordingly, two possible roads to affluence. The Galbraithian course makes assumptions peculiarly appropriate to market economies... But there is also a Zen solution to scarcity and affluence, beginning from premises opposite from our own, that human material ends are few and finite and technical means unchanging but on the whole adequate. Adopting the Zen strategy, a people can enjoy an unparalleled material plenty, though perhaps a low standard of living. (Sahlins, 1968: 85)

However, as Rowley-Conwy (2001) points out, many forager societies do not fit the flexibility, mobility, and social equality of Sahlins's Original Affluent Societies. In particular, in 'delayed return' systems of foraging the storage of food and other materials provides a means for the development of notions of cultural property and differential rights of access to resources more akin

to those typical of most agricultural societies. Some of the sedentary forager societies of the north-west coast of North America, for example, were divided into chiefs, commoners, and even slaves (Donald, 1997). The construction and ownership of specialist equipment could favour differentials in access to resources: ‘a fish trap involves considerable labour, and the trap and its catch will therefore belong to those who constructed it’ (Rowley-Conwy, 2001: 40). Ownership of portions of territory (such as the fish trap and its location) and ownership of storable food favoured hierarchical rather than egalitarian social structures. On such differences anthropologists and archaeologists have tended to divide foragers into ‘simple’ and ‘complex’ societies, but Rowley-Conwy (1999b) proposed a spectrum of increasing complexity, spanning four main social and economic categories of foragers: (1) groups with little or no logistic movement of resources or food storage; (2) logistic groups that do not defend territories; (3) logistic groups that do defend territories; and (4) sedentary groups who invariably defend territories and store resources. Examples of Type 1 groups would be the !Kung-San and some Aboriginal desert groups in Australia, of the ‘typical’ Original Affluent Society model. The Inuit of Alaska and other northern latitude hunters would be examples of Type 2 foragers. Type 3 was represented by most ‘delayed return’ foragers, with particularly complex groups such as the Kwakiutl and the Thule Eskimo comprising Type 4.

Evidence for interpersonal violence, raids, and blood-feuds, endemic amongst many non-Western agricultural societies, is surprisingly common amongst modern foragers, in contrast with the world of ‘caring sharing’ foragers portrayed by much of the anthropological and archaeological literature (Lee and Daly, 1999: 5). In general, records of violence amongst recent foragers refer especially to periods just before and during colonial pacifications, and the extent of violence amongst these societies before colonial contact is less clear (Bamforth, 1994; Moss, 1992). Nevertheless, the archaeological record suggests that interpersonal violence has been more or less endemic certainly since the Upper Palaeolithic (Vencl, 1999), and as we shall see in later chapters, the archaeological record of many regions of the world frequently contains evidence for violence amongst transitional forager-farmer societies, most commonly in contexts of developing semi-sedentism or sedentism and related demographic stress.

DEMOGRAPHY

In extreme environments, such as the Arctic or the Australian desert, forager population densities may be less than 0.1 person per square kilometre. At the other extreme, densities of 50–100 people per square kilometre are known to

have been sustained by some semi-sedentary coastal communities in North America that were reliant heavily on fishing (Hassan, 1975).

It has commonly been assumed that mobile foragers have more or less stable populations, of necessity. The woman cannot have another child to carry until the current babe-in-arms can walk from camp to camp unaided, usually at about two years of age (Lee, 1979). Hence foragers are commonly described as practising a variety of behaviours in order to keep their numbers down, including long lactations and related intercourse taboos, contraception, and in the last resort infanticide. Numbers are also kept down by the heavy workload women undertake, the young age at which they first bear children, the lack of nutritional weaning foods, and the hazards of childbirth.

Accurate demographic data on foraging societies are hard to come by, but a recent survey found a wide range of fertility and survival rates (R. Pennington, 2001). Population simulations indicate that forager populations are more likely to be characterized by cycles of boom and bust than stability or very slow growth, with boom times balanced by periods of epidemics and famine reducing survival to the worst levels, creating near-zero growth (Boone, 2002). The survey indicated that healthy forager women were producing 6–8 births in their lifetime, but that infant mortality was usually high. The survival rates of mobile !Kung-San and Hadza bands are particularly low—only about half of newborn children survive to age 15—whereas amongst recently settled groups of !Kung-San and Aché (Paraguay foragers), the chance of surviving to age 60 is better than 50 per cent. Survival rates have commonly improved in recent decades, in part due to disease control from access to Western medicine but in particular from improvements in weaning diets—the !Kung-San, for example, trade with local pastoralists and farmers for cow's milk and fine-quality grains. Life expectancy for our own sedentary industrial societies is more than twice that of foraging societies, because of the role of sanitation, immunization, and antibiotics in the control of infectious disease, but it is noteworthy that the incidence of degenerative diseases such as obesity, diabetes, coronary heart disease, and cancer is far lower amongst foragers (Boyd Eaton and Eaton, 1999).

ETHOS AND WORLD-VIEWS

For medieval philosophers the natural world was part of a divine order, but Enlightenment scientists and philosophers such as Galileo Galilei, Francis Bacon, René Descartes, and Isaac Newton developed a view of the relationship between nature and culture that has underpinned Western notions of philosophy, rationality, and science ever since (Tarnas, 1991). The basis of

Descartes's method and philosophy, for example, was radical doubt and analysis, a hierarchy of mind over matter (though both were divine in their creation). Alongside this mind : body dualism was a nature : culture dualism: the material world was a machine, working according to mechanical laws, to be measured by the human brain in terms of number, magnitude, and position, to be explained scientifically and objectively in terms of its arrangement and movement of its parts much like a clock. Such a rational view of the universe not only separated culture and nature but also privileged the former over the latter: humans were superior to animals and the rest of the natural world, nature was something 'other', to be explained and controlled. 'The idea of man's control over animality (including his own and that of women) is part and parcel of a more inclusive ideology of the human mastery or appropriation of nature, whose roots lie deep in the traditions of Western thought' (Ingold, 1994: 11).

The Western concept of a nature : culture dichotomy was produced and reproduced in particular historical circumstances (Cronon, 1996; Evernden, 1992; I. G. Simmons, 1993). The European colonial experience reinforced the concept: indigenous societies, far distant from the centres of science and reason, were part of nature, to be studied scientifically as objects. The notion has clearly underpinned most past and much recent thinking by Western scholars about foragers and farmers in prehistory, and the transition between the two. Foragers have invariably been seen as interacting with nature, or being part of nature, whereas farmers controlled, and intervened in, nature. The Victorian notion of the forager way of life as primitive barbarism (Table 1.1) can be understood in the light of this nature : culture dichotomy: foragers lacked culture, because they manifestly did not control nature.

However, it is clear from modern ethnographic research that most foragers conceptualize relations between humans and their world in ways very different from our own Cartesian model. Commonly, the environment is regarded as a benign spiritual home 'embracing all manifold beings that dwell therein' (Ingold, 1996: 128). Relations with it are modelled on the same principle of sharing that applies within the human community: it is the source of all good things, a 'giving environment' (Bird-David, 1990, 1993). Many foragers do not distinguish between their own fortunes and the character of the world around them, using metaphors such as procreation, parenthood, and kinship to describe their relations to their environment. Land needed for living in is appropriated not by fences and boundaries, in the way of farmers, but by moving through it along paths. Thus a forager's territory is something to be *related to* and *associated with*, not *owned*, and tracks and paths are symbolic of the process of life itself: 'who one is becomes a record of where one has come from and where one has been' (Ingold, 1996: 138).

In contrast with the Western concept of naturalism, most foragers are characterized by ‘animistic’ or (less commonly) ‘totemic’ belief systems. In the former, non-human animals are not just *like* humans, they *are* persons. Their environment is a treasure house of ‘personages’, each with language, reason, intellect, moral conscience, and knowledge, regardless of whether the outer shape is human, animal, reptile, or plant. Thus the Jivaroan people of eastern Ecuador and Peru consider humans, animals, and plants as ‘persons’ (*aents*), linked by blood ties and common ancestry (Descola, 1996). Foragers with animistic belief systems commonly do not have words for distinguishing between people, animals, and plants as separate categories, using instead classification systems based on terms of equality rather than the hierarchies of our own Linnaean taxonomies (Howell, 1996). The totemic systems of Australian Aborigines use ceremonies and rituals to stress an abstract linear continuity between the human and non-human communities. Animals are the most common totems, signifying a person’s or group’s identity or distinctiveness, but though they may be good to eat or food for thought, they are not considered social partners as in the animistic belief systems.

The forager world is animated with moral, mystical, and mythical significance (Carmichael *et al.*, 1994). It is constructed and reconstructed through the telling of myths, which commonly include all kinds of animals as humans, changing shape between one and the other. In addition to the present world inhabited by humans and non-human beings, there is a supernatural world. In many forager societies, shamans mediate between the lived and supernatural worlds, entering and conceptualizing the latter, commonly through ecstatic experiences. One of the mythological beings featured in forager cosmologies the world over is the Trickster: part god, part culture hero, transforming beings from the mythic past in morally ambiguous ways (Guenther, 1999: 427). As the whole world is self, killing a plant or animal is not murder but transformation. Finding food is taken for granted, reinforced by myths telling the hunter to *be* the animal before presuming to kill and eat it. ‘They are being heard by a sentient conscious universe—a gallery of intelligent beings who, if offended by injudicious words (ridicule, bragging, undue familiarity, profanity, etc.) can take reprisal, usually by a steadfast refusal to be taken as food or by inflicting disease or doing other violence’ (C. L. Martin, 1993: 14). The many examples of native Americans ‘lying’ to Europeans about how the deer were few and far between, the hunting difficult, and so on, when the Europeans could see that the landscape was teeming with game, can now be understood in terms of hunters being respectful about and to their fellow beings.

By contrast, settled farmers typically see themselves at the centre of a series of circles of decreasing familiarity: ‘from home, farm or village to

the wild periphery where danger threatens' (Tapper, 1994: 54). The farmed land is clearly separated from the wilderness beyond, commonly by physical boundaries. The agricultural economy is built around relations with people. Cooperation and the continued necessity of cooperative labour link and bind people, both to those involved in the current cycle of production but also to those who produced the previous cycle, thus creating a cyclical renewal of the relations of production that theoretically never ends (Meillassoux, 1972). In his comparison of Mullu Kurumbu farmers and their Nayaka forager neighbours in southern India, Bird-David (1990) contrasted how the Nayaka viewed the forest unconditionally as a parent, whereas the Mullu Kurumbu viewed their land as an ancestor that gave its wealth reciprocally in return for favours rendered.

FORAGERS AS PRODUCERS AS WELL AS CONSUMERS

Despite the traditional definitions of foragers as consumers and farmers as producers, the differences are often not nearly so clear-cut (Keeley, 1995). The following discussion is not meant to be exhaustive, but examples are cited of a variety of foraging societies in different habitats to show the ways in which their responses to their environment often reveal something of the behaviours traditionally regarded as the exclusive preserve of cultivators and herders.

Deserts and Semi-Arid Regions

The Aboriginal population of Australia at the time of European contact has been estimated at about a million people. Their society was clan-based, with groups of related clans in language groups, of which there may have been as many as 200. The peoples of the vast arid and semi-arid regions of the interior were generally extremely mobile, reliant especially on vegetable and seed staples (Cane, 1989; Gould, 1968, 1969; Harris, 1984; Kimber, 1984; Lourandos, 1997; Veth, 1987). Edible seeds were collected from more than 70 trees, shrubs, and grasses. One of the most important food sources was *Panicum decompositum*, the so-called native millet of Australia, which was harvested by hand without the aid of any tool, either by stripping the seeds from the plant into a dish, or uprooting the whole plant. The seeds needed to be roasted to remove the husks, so in the first method the seeds were lightly parched in a fire, whereas in the second system the plants were stacked together and burnt and the seeds collected from the ash. Seed-gathering was mostly by hand without tools, but these Australian gatherers then processed



Fig. 2.6. Biddy Simon and Polly Wandanga, Aboriginal foragers in the Northern Territory, Australia, dig for goanna in burnt pandanus woodland in the Keep River area (Head, 2000: illustration 8.2a; photograph kindly provided by Leslie Head, reproduced with the permission of Biddy Simon and Polly Wandanga)

their harvests using the same techniques that early farmers used to process their cereals to produce an edible flour: threshing, winnowing, parching, and grinding (Harris, 1984: 65). Other horticulture-like activities that have been recorded included burning brush to enhance vegetation growth (Fig. 2.6), constructing earth dams to divert floodwaters to irrigate land (Tindale, 1977), sowing seeds in places where the plants were not growing to extend their range, and storing seeds to extend the period of their availability. Seeds were stored in a variety of grass, skin, and wooden containers underground; one such store that was observed contained over a ton of seed (Harris, 1984: 65).

The American Indian tribes of the Great Basin between the Sierra Nevada and the Rockies, such as the Paiute and Shoshone, were also heavily reliant on the collection of grass seeds, and many of their strategies were similar to those of the Australian Aborigines (Steward, 1933, 1941; D. H. Thomas, 1981). They harvested seeds by beating the plants with wooden paddles, knocking the seeds into baskets. The seeds were then processed by threshing, winnowing, sieving, parching, and grinding. Seeds were stored in pits, and some groups broadcast seed along stream channels. Mostly the irrigation relied on natural flooding after rains, but in the nineteenth century the Paiute of the Owens valley are known to have constructed dams and ditches to divert floodwaters onto adjacent land. There has been much discussion about whether the latter techniques were acquired through contact with Spanish or native American farmers, but the balance of probability is that they were not (Lawton *et al.*, 1976). The cleared and sown plots, like groves of pinyon trees, were generally the communal property of the communities who made them, but there are

some indications that ownership may sometimes have been at the household level comparable with the land tenure systems of most farmers.

The Kalahari San also relied heavily on collecting plant foods. Lee (1979) lists 105 plant species that the !Kung-San recognized as edible, fourteen of which were regularly utilized; the rest were collected only if the primary sources failed, or as snack foods. Many nineteenth-century explorers report how Kalahari foragers burnt vegetation especially to encourage the growth of food plants and to remove competing plants, and to encourage young shoots for game. Stands of mongongo trees were protected from such burns by making fire-breaks around them. Other forms of plant manipulation that have been observed include replanting certain species near base camps, and the intentional cultivation of at least one species of melon. The San have also extended the range of the mongongo tree (Lee, 1973).

In semi-arid regions of Australia, gathering was increasingly augmented by hunting, fowling, and fishing. The Bagundji of the Darling basin in New South Wales, for example, had developed highly specialized fishing techniques using stone traps and wickerwork weirs, and waterfowl were trapped with large nets strung over rivers (Allen, 1974). In southern California, too, the tribes planted maize, beans, and squash, but they relied for their livelihood more on hunting, fishing, shellfish collection, and plant gathering (Bean, 1972; Shipek, 1989). The growth of wild plant staples was promoted using a range of 'husbandry' techniques that included vegetation burning, seed broadcasting, tree planting, and transplanting. Firing vegetation was routine, for a variety of purposes (Anell, 1969; Lewis, 1973): to stimulate rapid regeneration of seed-bearing plants; to stimulate growth of young shoots likely to attract game; to trap game within a ring of fire; to produce young straight hazel rods for basketry; and to clear vegetation round oak trees to make collecting acorns more efficient. Along with hunting game, the people also kept doves and quail in cages for their eggs, and there is a record of a village chief keeping breeding pairs of rabbits in a deep hole to provide his community with a steady meat supply (Shipek, 1989: 166).

Tropical Forests

There have been extensive studies of the Aboriginal peoples of the northern tropics in Australia: in Arnhem Land, Cape York, and the coastal islands (Altman, 1987; Beaton, 1982; Hynes and Chase, 1982; Meehan, 1982; Rowland, 1986; Thomson, 1939; Tindale, 1977). The communities living in or near coastal wetlands were seasonally semi-sedentary, mobile at other times of the year. The Wik Monkan in western Cape York were mainly nomadic through

the dry season (May–October), but then gradually retreated to the coast, digging wells for water and living mainly on tubers, hunting, and fishing. In the wet season (November–April) they fished and collected crabs, shellfish, and birds' eggs, and harvested yams, tubers, and seeds. There were also specialized marine-orientated societies on the coasts, and the richest rainforests supported relatively sedentary and more populous groups more reliant on plants.

As well as having an intimate knowledge of the plants, animals, and fish on which they depended, these tropical foragers commonly undertook measures to improve their food supply. Cycad seeds were one staple food, and cycad groves were burnt to increase their overall productivity. Many roots and tubers were propagated: in the case of yams, for example, 'it used to be common practice at the time of the harvest for the top of the tuber from which regeneration takes place to be either left in the hole or broken off and replanted in the same or nearby hole' (Harris, 1977: 437). Shade trees were planted around regularly used campsites, and other plants deliberately seeded there. Amongst the more populous coastal communities, concepts of territorial ownership had developed, demarcated by planting, and with prized resources such as coconut trees owned by particular groups. Yams were stored from one season to the next, especially to create an abundance of food for ceremonial feasts. Other horticultural-like activities included a variety of laborious processing activities such as leaching, drying, fermenting, and roasting, to remove toxins from cycad seeds, yams, and other plants. Whilst these foragers may not have been domesticating plants, it can be said that they were domesticating the environment in which the plants they gathered were growing (Yen, 1989: 62).

The Penan of the tropical rainforests of Borneo inhabit areas several days' walk from farming communities, and though they trade with them for items such as tobacco, metal, cloth, salt, and batteries, they do not trade for rice, maize, or cassava—they are self-sufficient in terms of their staple foods (Brosius, 1991). Most calories come from hunting pigs with dogs and spears, and the primary source of carbohydrate is sago starch from the palm *Eugeis-sona utilis*. Adult sago trees are felled and the pith collected and processed—Brosius estimated that three people working for six hours could process about 50 kilograms of starch a day (Fig. 2.7). The sago palm grows in clumps of 3–6 trees, and the Penan deliberately seek to maintain equilibrium in sago numbers by careful thinning and allowing clumps to regenerate. They practise a form of stewardship or protection termed *molong* ('fostering'), whereby particular trees are marked by individuals as reserved for harvesting at a later date, or entire areas are left for a decade or more to regenerate. As other examples of *molong*-type practices amongst tropical hunter-gatherers, the pygmy foragers of the western Congo and the Baka of the Cameroons leave portions of exploited yams in the ground, the Siriono of Bolivia have extended the range



Fig. 2.7. Penan foragers in Sarawak, Borneo, producing sago starch: (*left*) pounding the pith, and (*right*) washing the pith to produce the edible sago (right photograph after Brosius, 1999: fig. 81; both photographs kindly provided by J. Peter Brosius)

of the papaya, and the Kubu of Sumatra created 'hidden gardens' of yams deep in the primary forest as a fall-back resource in times of shortage (Bahuchet *et al.*, 1991; Bailey and Headland, 1991; Holmberg, 1950).

There are also other situations in which societies practise mixes of foraging and farming outside the norms of archaeologists' expectations of the past. The Etoro farmers of New Guinea, for example, have sows roaming freely around their settlements, which breed with feral or wild boars in the forest. The litters of piglets are then brought into the longhouses and fed and cared for for 3–6 months, so as to develop a permanent attachment with their owners. 'Each piglet is individually named, its ears are clipped to make it readily distinguishable from wild pigs (which are hunted), and the males are castrated' (R. C. Kelly, 1988: 115). As the piglets get older they wander further but 'are frequently encountered in the course of daily activities. On these occasions a pig is invariably called by name, stroked, scratched, and fed bits

of food in order to renew its familiarity with it. Any pig, whether recently reared or mature, will be sought out by its owner to receive such ministrations if it has not been sighted by some member of the community for more than a week' (Kelly, 1988: 115–16). This system of breeding domestic sows with wild pigs maintains a single genetic population. An archaeozoologist using the methodologies described in the next chapter to identify wild from domestic animals would simply detect a single population in an Etoro faunal sample, even though both wild and domestic individuals are present.

Temperate Forests

In the temperate regions of southern Australia, including Tasmania, where resources were generally more plentiful than in the deserts and tropical forests, forager societies were generally sedentary and populous. They were dependent especially on fishing, augmented by the hunting of a broad spectrum of game and the collection of a wide range of rhizomes, corms, bulbs, and tubers that first needed digging out and then processing by pounding, leaching, roasting, and so on to make them edible. Vegetation was burned off to encourage plant growth, and plants were stored. This regime of firing, gathering, and digging might well be categorized as a form of 'natural cultivation' on the part of the southern Australian Aborigines (Gott, 1982: 65; see also Flood, 1980; R. Jones, 1974; Lourandos, 1976; Poiner, 1976), and P. White (2003) goes further to argue that at their most developed these techniques amounted to agro-systems that can legitimately be classified as agriculture (Chapter 6, pp. 227–8).

In the temperate woodlands of North America, hunting was everywhere important and the hunters' extensive knowledge of animal behaviour is repeatedly stressed (Campbell, 1968). There is consistent evidence in most of these societies for the widespread use of fire to improve browse for game, as well as to trap game in hunting drives (Anell, 1969; Mellars, 1976; Stewart, 1956). Certain locations sustained semi-sedentary and populous communities, especially where the fishing was plentiful. The Ojibwa of northern Ontario (Rogers, 1962) relied almost exclusively on fishing between June and September, and dried and preserved fish were important later in the year as people turned first to hunting small game and moose in the autumn, then hunting moose and trapping beaver in the winter, and then small game hunting in the spring. Before European contact, people in the eastern woodlands made no use of cultigens but used a variety of storage and preservation techniques to enhance their food supplies: fish, shellfish, and meat were dried and smoked, nuts were cached in pits or above-ground stores, fruits were preserved by drying (P. J. Watson, 1989). The Tlingit and the Lummi were typical of the

north-west coastal tribes in relying for most of the year on salmon and other fish sources (Oberg, 1973), but the Lummi also practised a system of horticulture to produce supplies of the camus root that was also an important supplement. The Ojibwa-Chippewa were another group of hunter-fisher-gatherers who practised a form of horticulture, sowing and harvesting wild rice.

The Northern Tundras

One of the most effective adaptations to living in the tundras of North America has been caribou (reindeer) hunting. Large herds of caribou migrate over enormous distances from their winter shelter in the northern forests to calving areas on the tundra, along more or less predictable routes. In the Hudson Bay area of Canada, Chipewyan bands positioned themselves at locations where they could intercept the herds as they left the tundra (J. G. E. Smith, 1978). Although they also hunted for other game, fished, and collected plants, they relied above all on the caribou. Probably because of the dire consequences for a band if a herd changed its migration route, and reflecting also the resource crashes that can affect extreme latitudes, the Chipewyan developed complex alliance networks between adjacent groups underpinned by marriage ties. Kin relations were underpinned by frequent visits to neighbouring bands, a mechanism which also spread information about caribou numbers and movements. If a herd failed to traverse its territory, in the last resort a group could be absorbed by its neighbours. Alaskan society was characterized by similar cooperative mechanisms between neighbouring bands, though contact between regional groups was often hostile (Burch and Correll, 1972).

Like desert hunter-gatherers, these tundra hunters needed enormous territories in which to operate: a band of five families of Nunamit in the Brooks Range of Alaska had a residential core area of 5,400 square kilometres, and a total annual range of about 25,000 square kilometres (Binford, 1983; Fig. 2.8). The main residential bases were usually near the Anaktuvuk pass or by Tulugak Lake, the best locations for water and firewood, the lake being used especially in the summer for trout fishing. Caribou migrated through the band's territory in the spring and autumn on the way to and from their calving areas on the northern tundra, using the Anaktuvuk and John river valleys. The herds were generally intercepted at various locations between these two camps (though hunters also ranged over the whole territory at other seasons), the animals killed being butchered where they lay, and their meat either dried on racks or, when temperatures were below freezing, cached under stone cairns. People would go back to the caches as and when required to take meat back to the community, the meat being protected from predators by deadfall traps (boulders set to crack down on the unfortunate neck of any hungry wolf or fox).

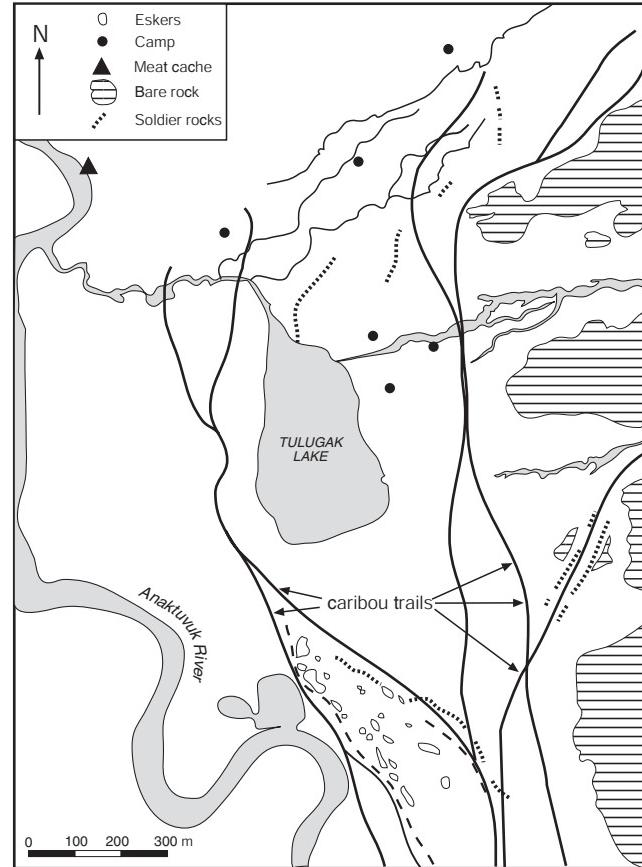
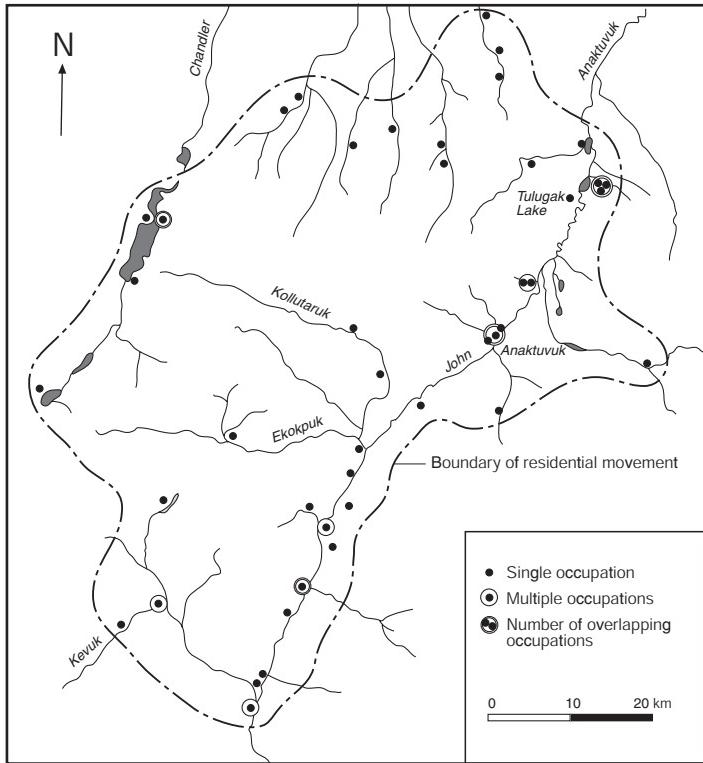


Fig. 2.8. (left) The territory used by a band of about five families of Nunamiut in northern Alaska and (right) detail of the Tulugak Lake area showing caribou migration routes, drive lines, 'soldier rocks', camps, and meat caches (after Binford, 1983: 112 and 126)

As well as simply taking advantage of the natural migration routes of the caribou, the Nunamiut employed other methods to give themselves the best chance of a good kill. Pairs of hunters stationed themselves along the caribou routes, either taking advantage of natural cover such as clumps of willows, or hiding behind artificial hunting blinds, half-circles of stones. They endeavoured to channel the caribou between natural drive lines formed by parallel lines of glacial hillocks (eskers), constructing 'soldier rocks' (in effect stone scarecrows, cairns made to look human with lumps of moss and clothing) in any gaps between the eskers to frighten the deer from trying to escape through these gaps (Fig. 2.8b). The strategy was to try to force the deer between the drive lines into natural traps such as up an isolated hill or into a natural enclosure by a lake from which escape was difficult.

A reindeer herding system established by Lapp herders in Greenland made use of rather similar tactics in the management of the herds (Sturdy, 1972). In winter the herds grazed coastal valleys, in summer they migrated to higher ground inland. The deer were left alone in the mountains in the summer, because the summer grazing there was naturally enclosed by fjords and mountains, but as the winter grazing areas were not naturally enclosed the herders had to take shifts to camp out near the deer to drive strays back into the territory (in effect acting as human 'soldier rocks' at potential exit points). The Lapps sited their main camp at the pass connecting the summer and winter grazing areas. They rounded up the herds in the spring and autumn to drive them between the pastures, culling them at the pass during the autumn migration. The herding system was very 'hands-off': 'by allowing the deer to see or smell a man in a given position ... they will move away from the scent or sight in a desired direction' (Sturdy, 1972: 167). Like the Nunamiut, they constructed drive lines, in this case long wooden fences, leading into natural paddocks enclosed by cliffs and water, where they could lasso particular animals selected for slaughter (mostly young males, though also sickly or weak animals). Their system of management lies somewhere between the hunting system of the Nunamiut and the herding system of a British hill farm, in which sheep are left in the hills for most of the year and rounded up for lambing and culling.

A similar mix of hunting and herding, of semi-wild and semi-domestic animals, is described by Pekka Aikio (1989) in his memories of how the Sámi of the interior of Norway, Sweden, and Finland managed reindeer in his childhood. This was before the modern trend to use them as a wild resource for rich foreigners to shoot, like red deer on Scottish estates. Some reindeer were hunted, the Sámi constructing obstacles such as fences and trenches to drive the deer into natural cul-de-sacs and tethering decoy animals if they needed to capture wild reindeer. Rock carvings indicate similar practices in

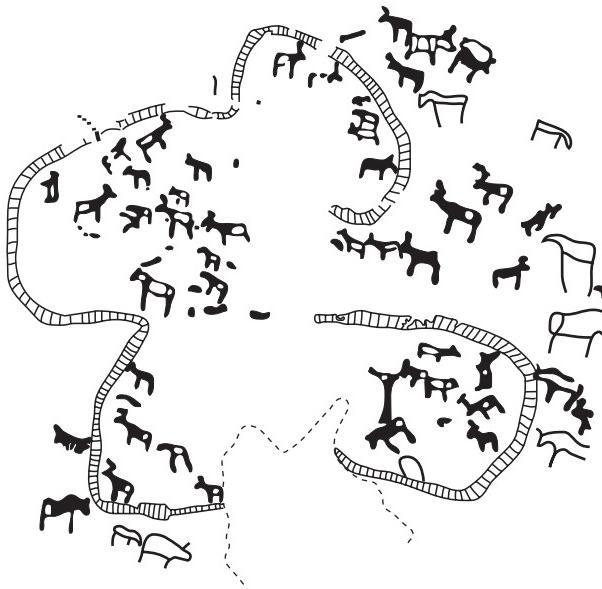


Fig. 2.9. A prehistoric rock carving from Jiebmaluok'ta near Alta, Norway, thought to date to c. 4000 BC, showing reindeer inside and outside a fenced corral. The Sámi of the region in recent times used tactics like this both to hunt wild reindeer to kill, or to capture them to incorporate them within their (semi-domestic) herds (after Aikio, 1989: 176)

prehistoric times (Aikio, 1989: 175; Helskog, 1977; Fig. 2.9). Other reindeer were herded, though the system was to leave them alone for much of the year, when they inevitably mixed with the wild population:

My earliest memories concerning the 30 semi-domesticated draught reindeer which we had at home come from the time when I was four or five (I was born in 1944). My father was extremely overjoyed when a son (myself) was born to him, and he notched his personal reindeer ownership mark on the biggest and strongest male reindeer calf that he owned. Later this reindeer was castrated. When I was five years old, this reindeer, called Sloagga, was the master of the herd. My special job was to prepare a treat every day out of rye flour and water which was only served to Sloagga. This leader of the herd with his big antlers always remembered this, and every day during winter he came with his herd to pay us a visit in our yard... The reindeer passed a couple of hours in our yard and then went back to feeding on lichen in the nearby forest... The reindeer were, as a general rule, domesticated. Of course, there were wild reindeer in the herd. But the herd as a whole was not nearly as wild or undomesticated as it is at present. (Aikio, 1989: 169–70)

CONCLUSION

In his discussion of the foragers of northern Australia, Harris (1977) pointed out that the nearer they were to the horticulturalists of Papua New Guinea,

Table 2.3. A comparison of population densities of some New Guinea shifting agricultural societies and some Australian and Tasmanian foraging societies, showing an unbroken continuum from intensive farming to generalized foraging

Population	Population density (km ² per person)	Economy
New Guinea		
Duna	0.1–0.25	Intensive shifting cultivation (mounded sweet potato)
Oksapmin	0.13–0.1	Shifting cultivation (taro, sweet potato)
Southern Hewa	1.6	Shifting cultivation (sweet potato), hunting
Wonio	1.0	Shifting cultivation (taro), hunting-gathering
Saiyolof	1.1	Shifting cultivation (taro), hunting-gathering
Baktaman	1.3	Shifting cultivation (taro), hunting-gathering
Australia (north)		
Gidjingali (coastal)	1.29	Hunting-gathering-fishing
Australia (south)		
Whuurong (coastal)	1.4–2.5	Hunting-gathering-fishing
Tjapwurong (inland)	2.5–3.3	Hunting-gathering-fishing
Tasmania		
Coastal north-west	5–10	Hunting-gathering
Coastal south-west	11–14	Hunting-gathering

Source: Lourandos, 1997: 37.

the more their subsistence was orientated towards horticulture; there was a changing spectrum from foraging to horticulture, not a simple dichotomy. These arguments can be extended to apply to the region as a whole: there was a cline in modes of subsistence from Australia to New Guinea, with hunting and gathering at one end and intensive farming at the other, with most societies in between (Lourandos, 1980, 1997). Moreover, as Table 2.3 shows, the cline from low-intensity foraging to intensive farming is also paralleled by a cline from most mobility to least mobility, and from low to high population densities. The food surpluses created by the 'horticulturalist' activities of Australian foragers enabled them not only to deal with seasonal fluctuations in supply but also to sustain population agglomerations for short periods, conduct ceremonial feasts, and promote social alliances (Chase, 1989; Lourandos, 1997). Moreover, the most populous and semi-sedentary Aboriginal populations of Australia were also characterized by social competition and strongly territorial behaviour that could include ritualized inter-group combat, behaviours far removed from the traditional definitions of foraging societies but endemic, for example, amongst New Guinea farming communities. Exactly the same points can be made about the recent foraging and farming societies of tropical

South-East Asia and South America (Bailey and Headland, 1991), sub-Saharan Africa (Hall, 1987), and North America (Bicchieri, 1972): there was a spectrum of subsistence behaviour from 'pure' foraging to 'pure' farming. In every region there have been examples of areas with plentiful food sources sustaining forager populations characterized by high population densities, sedentism, well-developed territorial behaviour, and competitive behaviours.

Although many forager societies practised forms of activity akin to horticulture or herding, it is important not to exaggerate the extent to which most recent foragers have deliberately practised horticultural-type methods, or thought like farmers in their relations to nature. For example, although the Nukak of Columbia concentrate on the exploitation of artificial concentrations of key staple plants such as *seje* (*Oenocarpus bataua*), intentional planting or horticulture has never been observed, and the clumps seem largely to have grown up from the dumps of *seje* seeds left behind at abandoned campsites (Politis, 1996). Whilst Australian Aborigines' use of fire was purposeful, and was for goals very similar to those of farmers who practise burning, some of their other horticulture-like activities can be regarded as inadvertent side-effects of the harvesting techniques they employed (Yen, 1989). Most do not seem to have been seeking deliberately to modify their environment in the way farmers do in order to look after the physiological needs of their cultigens. The same point is true of the hunting tactics of the Nunamiat. Although many Gidjingali foragers in Arnhemland had lived on government and missionary settlements where they had become acquainted with what farmers did, plant agronomy was for them very much an incidental or implicit process, not a deliberate attempt to use horticultural techniques to raise yields:

The Gidjingali had a deep sense of 'curation' of the country and of its spiritual essence; indeed, this was one of the mainsprings of their world view. Despite this, in an ecological sense, they saw themselves as hunters. Gardening or farming in an explicit interventionist sense was the way of life of other people. (Jones and Meehan, 1989: 129)

Yet of course the archaeological record shows that throughout the world many prehistoric foragers *did* develop a commitment to agriculture. Though the process was highly variable, as the later chapters of this book will describe, it is clear that prehistoric foragers invariably developed new ways of thinking about themselves in relation to their environment in the process of making the transition, in contrast to present-day foragers like the Gidjingali (see Chapter 10).

The traditional definitions of foraging and small-scale farming societies used by anthropologists and archaeologists have posited two entirely contrasting ways of life, social relations, and ideologies. However, as this

chapter has described, the reality is far more complicated. Foraging societies vary enormously in degrees of mobility, breadth of diet, the use of storage and other technologies, and so on. At one end of the spectrum of forager ethnography there are (or have been) foraging societies fulfilling many of Sahlins's predictions of 'original affluent societies': highly mobile, small in number, subsistence-based, and egalitarian. At the other end are (or were) societies with many of the attributes normally regarded as typical of agricultural societies: sedentary or semi-sedentary, populous, surplus-producing, and hierarchical. In addition to this enormous variety of societies within the 'pure' foraging category of people subsisting entirely on wild plants and fauna, we know from the ethnographic and ethnohistoric record of foragers who also farmed, farmers who also foraged, farmers who relied on a mix of domestic plants and stock, farmers who relied mostly on plant cultivation, and pastoralists who relied heavily both on keeping their own livestock and on trading with neighbouring farmers for plant staples. The complexity of the lifeways represented in the ethnographic and ethnohistoric record that is hidden within simple terms such as 'foragers' and 'small-scale agriculturalists' clearly has considerable implications for the archaeological study of why prehistoric foragers became farmers, in terms of both the methodologies we use to try to identify foraging and farming systems in the archaeological record (the topic of Chapter 3) and the theoretical models we then employ to try to explain foraging–farming transitions in prehistory.

3

Identifying Foragers and Farmers

INTRODUCTION

One of the most exciting aspects of studying transitions from foraging to farming is the extraordinary range of evidence available, and the necessary interdisciplinarity of the exercise (Barker and Grant, 1999; Dincauze, 2000). The primary data for whether prehistoric people were living as foragers or farmers (or combining activities, as was often the case) have been collected by archaeologists, from their surveys and excavations. For much of the history of study, subsistence patterns were inferred principally from interpretations of artefacts, settlements, and associated structures. More recently, studies of artefact use have been strengthened by the application of techniques of physical and chemical analyses of food residues attached to them. A vital strand of research has been on the environmental contexts in which early farming took place. Such studies, of sediments, soils, and the microscopic flora and fauna they contain, have contributed reconstructions at a wide variety of scales, from regional climatic and environmental histories of late Pleistocene and Holocene climatic change to the landscapes of single occupation sites—the recognition of signs of animal stalling, for example. From the 1960s onwards, priority has also been given on archaeological excavations to the collection of the organic materials that survive in many conditions such as fragments of animal bone and seeds and other fragments of plants, waste discarded from the consumption of food that is the primary evidence for systems of subsistence. In certain conditions even faeces may survive, telling us about individual meals. Human teeth and bone provide further information about diet.

Molecular biology is a new and exciting area of current research, with modern and ancient DNA (aDNA) being used to infer population histories and domestication processes (Jobling *et al.*, 2004; M. Jones, 2001; Renfrew and Boyle, 2000). Further contributions have come from linguistics: studies of present-day languages have been used in support of theories about how farming was spread by new language groups (Bellwood and Renfrew, 2002). The art systems created by foragers and early farmers are yet another source of information, amongst the most intriguing for their potential insights about

the beliefs of the people who created them. In short, there is a remarkably broad church of disciplines with contributions to offer, though integrating their findings can be challenging.

ARTEFACTS

Archaeology is usually defined as the study of the human past through material culture, distinguishing it from history, the study of the past through written documents. Objects or artefacts have always been the first source of evidence for archaeologists seeking to reconstruct the character of prehistoric societies, and in the first phase of studying the origins of agriculture they were the only evidence. Archaeologists working in historic periods can have recourse to historical sources to help them interpret their evidence, but prehistoric archaeologists have to attempt to interpret their material by other means. The traditional approach to the interpretation of how artefacts were used by prehistoric people was to make comparisons with how similarly looking artefacts are or have been used ethnographically. One of the first instances of this fundamental linkage between prehistoric archaeology and ethnography was in Renaissance Italy, when Michael Mercati, an employee of the Vatican, interpreted chipped stone objects found in the Italian countryside ('thunderbolts' to the peasant farmers who found them) as primitive axes because they were very like the stone axes used by some of the peoples being encountered by European voyagers to the New World (Schnapp and Kristiansen, 1999: 11). From such beginnings, combining ethnographic analogy with common-sense assumptions, archaeologists developed functional descriptions and interpretations of prehistoric artefacts: axe, knife, scraper, spear, harpoon, storage jar, plate, sickle, grinder, and so on (Table 1.1).

Certain classes of artefacts have long been associated by archaeologists with either hunting or farming (Fig. 1.1), and for many decades archaeological sites were classified as belonging to either hunter-gatherers or farmers on the basis of such associations. The presence of grinding stones, sickle blades, and/or polished axes on an archaeological site was commonly regarded as evidence for early farmers. Pottery was also regarded as the definitive artefact of the prehistoric farmer, though we now know that some prehistoric foragers made pottery long before farming was practised in their part of the world, and that some farmers did not. Also, we now realize from fuller appreciation of the ethnographic record that considerable caution is needed in the interpretation of artefact use on the basis of assumed associations. The spear can certainly be used for hunting, but a Masai herder would use it for collecting blood from his cattle. The tiny geometric microlithic flints made



Fig. 3.1. Biddy Simon, an Aboriginal forager in the Northern Territory, Australia, uses a digging stick to dig for yams in the Keep River area (Head, 2000: illustration 0.1; photograph kindly provided by Leslie Head, reproduced with the permission of Leslie Head and Biddy Simon)

by forager societies in the European Mesolithic are invariably interpreted as barbs and tangs that were set into resin on wooden shafts to make arrows, and indeed arrows of this kind have occasionally survived on archaeological sites with good preservation of organic remains, but the ethnographic record includes examples of identical microliths being mounted upright into wooden boards to make vegetable shredders (D. L. Clarke, 1976). The farmer will use a mattock or digging stick to prepare the ground, but foragers use similar implements for digging up roots and grubs (Fig. 3.1). Farmers may need axes for clearing trees in preparation for a field, but many prehistoric foragers also used stone axes to clear forest. The sickle can be used for harvesting a field of cultivated cereals, but it can also be used for harvesting a stand of wild cereals, or for collecting reeds or thatch for housing, or fodder for animals. The farmer needs a mortar and grinding stone for processing the cereal harvest, but foragers commonly use identical artefacts for processing wild plants, and both might use them for tasks such as crushing ochre for body painting. Many artefacts must also have changed in function and meaning during their lifetime: in Neolithic Italy, for example, stone axes that were probably intended primarily for carpentry in the regions where they were

made became exotic items on ceremonial pendants for distant societies who acquired them through exchange networks (Evett, 1975).

In some instances, of course, artefacts may be so specific that interpretations based on common-sense observations seem reasonably reliable. This is particularly the case when organic materials survive, for example in waterlogged or desiccated environments, as many such artefacts seem much more specific in function than stone tools. From Europe, for example, a series of primitive ploughs ('ards') has been preserved at waterlogged sites, and from the so-called 'lake villages' of the Alpine region dating variously to the Neolithic and Bronze Age have survived suites of specialized artefacts that seem clearly associated with particular subsistence activities such as hunting (bows and a variety of arrow types), fishing (harpoons, fish hooks, fishing nets, fish traps), farming and gathering (axes, adzes, mattocks, hoes, spades, baskets, sickles), dairying (buckets, ladles, sieves, butter churns), and textile production (carding combs, spindle whorls, loom-weights, needles, threads, fragments of cloth) (Barker, 1985: 119).

The importance of artefacts as indicators of subsistence activity has been considerably strengthened in recent years by archaeological science. How flint tools were used, for example, can be ascertained through microscopic examination of damage traces on cutting surfaces (P. Anderson, 1980; Keeley, 1980). Experimental work has established that different materials such as meat, bone, leather, wood, or plant fibres create different 'damage signatures', though studies of archaeological material will often be complicated by the use of the same tool on a variety of materials. The food or liquid that a pot once contained can sometimes be established by analysing residues present in the fabric of the vessel using gas chromatography and mass spectrometry, one of the main archaeological methods available for identifying the use of milk products (Copley *et al.*, 2003; Evershed *et al.*, 1991; Reber *et al.*, 2004; Rotländer and Hartke, 1982). Microscopic and isotopic analyses of organic material within clay fabrics, and phytoliths and starch grains adhering to vessel and stone tool surfaces (where they can survive many thousands of years), are providing further insights into plant collection and cultivation systems especially in regions of the world where macroscopic plant remains survive poorly (Barton and White, 1993; Beavitt *et al.*, 1996; Hastorf and DeNiro, 1985; Loy *et al.*, 1992; Piperno *et al.*, 2000).

STRUCTURES, SETTLEMENTS, AND FIELDS

From the Victorian writers onwards, early discussions of the differences between foragers and farmers usually assumed a straightforward dichotomy

in the kind of settlements they would have used. Foragers (hunters) were nomadic, using either caves as their temporary dwellings or ephemeral encampments likely to leave few traces in the archaeological record. With the discovery of farming 'the movable tent gives place to a permanently fixed dwelling' (Westropp, 1872: 13). Farmers lived in permanent settlements, they built houses, structures for the storage of food, and for the protection of their stock. Houses, in short, could be taken as clear signatures of sedentism and, by extrapolation, farming.

As in the case of artefacts, though, archaeologists have come to realize that straightforward associations of this kind are extremely dangerous. Mobile foragers often do not create with their campsites what an archaeologist would normally categorize as a 'settlement', in the sense of a dense concentration of material culture in one place. Rather, they tend to produce an 'off-site' or 'non-site' archaeology, a discontinuous spread of artefacts over, say, several hundred metres (Foley, 1981). However, as described in the last chapter, we also know of forager societies in the ethnographic record who were more or less sedentary, who built houses, and who stored foods in silos, and the same complexity is now known in the archaeological record. Studies of pastoralists show that many create 'non-site archaeology' like foragers, but others build substantial structures for themselves and their animals, though only for seasonal use (Bar-Yosef and Khazanov, 1992; C. Chang and Koster, 1986). Most agricultural societies today live in houses, but some live in caves. Many societies who farm but who also practise various combinations of hunting, gathering, fishing, or pastoralism use a variety of settlement structures in the year, some of which are substantial, others ephemeral (Fig. 3.2). The settlement units of small-scale agricultural societies also vary enormously today: the single household dwelling, with ancillary buildings for storage and livestock; hamlets and villages made up of sets of houses and barns; 'house-byres' in which people live with their animals under the same roof; the South-East Asian longhouse, in which an entire community lives in a single dwelling; and so on. In short, archaeologists have to be extremely cautious in making any assumptions about the degree of sedentism or mobility associated with a particular type of structure, or about the subsistence status and culture of the people who built it.

Yet structural archaeology can of course be extremely informative when interpreted with due caution, especially when there is good corroborative evidence from the analysis of artefacts and organic residues. For example, in the case of some prehistoric farming communities in central and north-west Europe, the floor plans of their houses suggest that space was allocated separately to humans and livestock, with internal partitions implying the stalling of cattle. This interpretation is corroborated by the high phosphate levels of the sediments in the stalls (confirming that animals were being kept



Fig. 3.2. The summer encampment used by an Italian shepherd in the Apennine mountains, who spends the winter in his home village at the edge of the mountains (photograph: Graeme Barker)

in them), animal footprints occasionally preserved in stalls, faunal samples dominated by cattle bones, and pottery assemblages that include strainer sherds for processing milk for cheese (Barker, 2000). In many regions of the world excavations of waterlogged sites in recent decades have provided a wealth of new information about prehistoric foraging and early farming societies.

To make the fields for their crops, early farmers often had to cut ditches, build walls, make terraces, and so on, and traces of the agricultural landscapes so created have frequently survived. Some of the most extensive evidence has been investigated by fieldwork, excavation, and air photography in north-west Europe. With a few exceptions (Fig. 9.19), most of these 'field systems', which survive as low banks of earth or stones preserved under modern pastures, heaths, and bogs, or as ditches in waterlogged localities, have been shown to have been built after the initial phases of farming (Fleming, 1988). In parts of Africa, Asia, and America, however, as much of the evidence for early farming has been assembled from the study of such landscapes as from excavations of the settlements of the people who built them (Denham *et al.*, 2003; Minnis, 2000; Sutton, 1998; Figs 6.19 and 7.8).

SEDIMENTS AND MICROSCOPIC ORGANIC REMAINS

The study of sediments, and of the microscopic flora and fauna they contain, provides critical information not only about the environment in which prehistoric foraging and early farming were practised but also about the activities of foragers and farmers. The environmental information provided is at a wide variety of scales, from global climatic change to how a particular building was used (A. G. Brown, 1997b; Dincauze, 2000; French, 2003).

Modern understanding of the global history of climatic change during the Pleistocene and Holocene has been established especially from oxygen isotope studies of foraminifera (microscopic organisms in ocean-floor sediments) (Dansgaard *et al.*, 1993). However, although this research has resulted in the abandonment of the old sequence of four great Pleistocene Ice Ages that was established by pioneering river terrace studies early in the twentieth century, the study of terrestrial sediments remains one of the principal techniques for establishing the course of late Pleistocene and Holocene environmental change at the regional scale (A. G. Brown, 1999; Fig. 3.3). The process begins with the mapping of superficial sediments and the description of sediment stratigraphies in terms of colour, texture, structure, and architecture. With further laboratory analyses of these physical properties, and of the geochemistry of the sediments, it is possible to identify the environmental conditions in which they developed, such as slow- or fast-moving water, wind action, hill-slope erosion, tectonic activity, and so on, some of which may be useful proxy indicators of the climatic conditions in which the sediments formed. Faunas contained in the sediments, from bones of large mammals and mollusc shells to microfauna and insect remains, provide further insights into the contemporary environment, from the inferences we can draw about their habitat preferences and tolerances. Changing vegetational regimes can be inferred from the microscopic plant remains that survive in many sediments, especially pollen and phytoliths (minute particles of silica from plant cells). In fluvial, estuarine, lacustrine, and marine sediments, diatoms (single-celled algae made of silica) provide further information about the changing histories of these environments.

The most detailed sequences of late Pleistocene and Holocene climatic history at the regional scale have generally been inferred from the vegetational histories established from the analysis of pollen cores taken from lake and bog sediments. Pollen analysis has proved a vital tool in detecting the impact of people on landscape ever since Iversen's pioneering study of the impact of Neolithic farmers on vegetation around the Ordrup Møse bog in Denmark (Iversen, 1941). The scope of study was dramatically enlarged in the late 1960s and early 1970s by discoveries of pre-farming forest clearances, particularly



Fig. 3.3. Reconstructing environment by geomorphological fieldwork in the Wadi Faynan, Jordan: (above) the present-day arid landscape; a Neolithic site, Tell Wadi Faynan, was situated on the edge of the main wadi channel in the distance; (below) the Neolithic settlement is located at the height in the section where the figures are standing; the sediments, and the flora and fauna contained in them, indicated that the climate then was significantly wetter than today's desert landscape, the Neolithic settlement being located in woodland beside a perennial stream (photographs: Graeme Barker)

in north-west Europe (I. G. Simmons, 1969, 1975a, 1975b). Throughout the world, palynology continues to be of profound importance in the study of transitions to farming because of its potential to reveal vegetational histories that are signatures not just of climatic change but also of the activities of foragers and farmers (e.g. Groube, 1989; Piperno and Pearsall, 1998). Confidence needs to be tempered with realism, however. For example, multiple sampling of pollen sites and fine-resolution sampling within each pollen core is essential if we are to be confident about distinguishing human activities from natural clearances caused by storm damage, disease, short-term climatic events (such as a run of unusually hard winters or dry summers), insect attack, and so on (A. G. Brown, 1997a; K. J. Edwards, 1989; Girling, 1988; I. G. Simmons *et al.*, 1989). Having established that a vegetational change is indeed the work of people, the task of distinguishing the nature of the land use—whether to encourage game, for example, or to create pasture for herds, or to create fields for crops, or for multiple uses—is also not nearly as straightforward as published pollen studies have sometimes suggested in the past, especially if based on a single core analysed with normal-resolution methodologies and without corroborative archaeological evidence from excavated settlements. Seabed pollen from Indonesia was once taken as evidence in support of human occupation of Australia over 100,000 years ago (van der Kars and Dam, 1995), whereas more detailed studies of charcoal signatures have pointed to human impact beginning 40,000–50,000 or so years ago (Beaufort *et al.*, 2003), findings which are much more in accord with the archaeological evidence for the human colonization of the region (O'Connell and Allen, 2004).

At the other end of the scale, all of these techniques can also be extremely informative in the analysis of human occupation sites, again in terms of both the contemporary environment and the activities of the people, sometimes including the season of occupation of a site. Information is always more prolific in anaerobic conditions of waterlogging or desiccation. The Neolithic settlement of Thayngen Weier in Switzerland is a good example of a waterlogged site where the study of the organic materials was enormously instructive (Guyan, 1981; Rasmussen, 1990; Troels-Smith, 1984; Fig. 3.4). Cattle byres were recognized because their sediments contained bedding straw, dung, high phosphate levels (caused by the dung), and the puparia of the common housefly, which likes to overwinter in warm cow houses. Structures containing sediments rich in macrobotanical remains of ivy, ash, twigs, clematis, and elm shoots, and high frequencies of pollen of these plants too, were identified as the barns where the winter leaf fodder was stored for the cattle. Studies of the physical and chemical properties, and the micromorphology, of sediments, can also be instructive regarding not just if animals were stalled at a site, but also which animals, and in what season (M. Charles, 1998; Courty *et al.*, 1990).

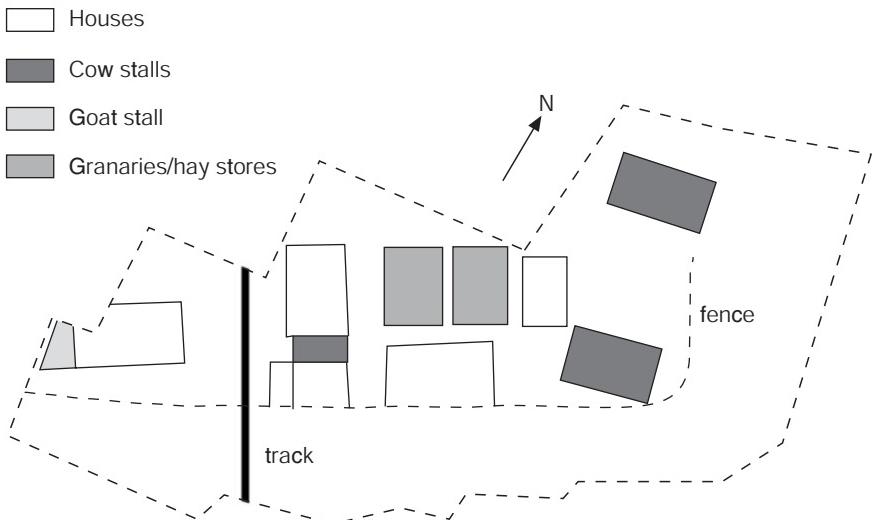


Fig. 3.4. Simplified plan of the main excavated portion of the Swiss Neolithic settlement of Thayngen Weier, with suggested functions of buildings and structures (from Whittle, 1988, after Guyan, 1981)

PLANT REMAINS

The archaeological record includes occasional discoveries of large quantities of plant material preserved in complete vessels, silos, ovens, and so on, but the first systematic studies of botanical remains from early farming sites were of impressions in fired clay, such as pots, ovens, and hearths (Helbaek, 1959). Plant residues were incorporated into clay either deliberately, added to clay to temper it during firing, or were caught accidentally, for example if a 'leather-hard' pot was placed to dry on a surface covered with straw. The method remains very useful, as for example in studies of the development of rice farming in South-East Asia and of sorghum and millet cultivation in Africa (Beavitt *et al.*, 1996; Thompson and Young, 1999; Fig. 6.15). Plants also survive in anaerobic conditions, such as waterlogged or desiccated remains, including coprolites (Fig. 3.5), or they can be mineralized by calcium carbonate replacement, commonly in latrine deposits. Much of the study of early farming in America was based on desiccated remains. Carbonization or charring will also preserve seeds and plant fragments (Figs. 3.6, 6.3). For example, some prehistoric cereals needed roasting to remove the husks, and these crops could be burnt accidentally in the oven, or of course they could be burnt in a larger conflagration. Much of the study of early crop farming in South-West Asia

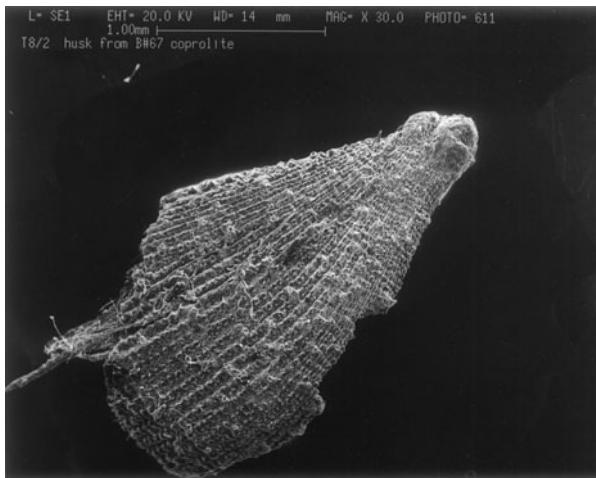
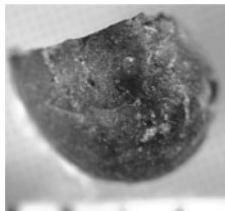


Fig. 3.5. Rice husk in a human coprolite from a second-millennium BC burial at Khok Phanom Di, Thailand
(photograph kindly provided by Gill Thompson)

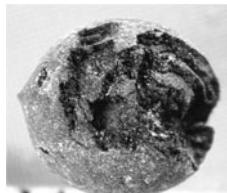
and Europe has focused on carbonized material, and a variety of soil flotation and sieving techniques has been developed to try to systematize its recovery (H. N. Jarman *et al.*, 1972). One of the problems with the development of studies of the transition from foraging to farming in both these regions was that for many decades flotation techniques were only used on sites assumed to be early farming sites, and their application in recent decades on earlier sites has yielded some of our most important information about the transition from plant gathering to plant cultivation (Chapters 4 and 9).

Another very significant development has been the application of AMS radiocarbon dating (the technique whereby extremely small fragments of charcoal can be dated) to carbonized plant remains, including individual seeds. This has made it possible to establish with reasonable precision the antiquity of particular seeds (particularly ones identified as early domesticated forms) rather than, as hitherto, date them by association with large samples of charcoal from the same stratigraphic context. In several cases the application of AMS dating has demonstrated that 'early domesticated seeds' were in fact much more recent in age and had become incorporated into the particular stratigraphic unit by some kind of disturbance such as animal burrowing—one well-known example was domesticated grain at Wadi Kubbaniya in the Nile Valley originally dated to 18,000 years ago but then demonstrated to be much more recent (Chapter 8, p. 285).

The problems of studying the beginnings of plant cultivation are particularly daunting in regions of the world where the main crops were root vegetables with stems, rhizomes, corms, bulbs, or tubers, that do not preserve in



Fabaceae (legume family)
Leang Burung-1



Prob. *Vigna* sp. (pulse)
Leang Burung-1



Prob. *Cucurbitaceae*
(Melon family)
Leang Burung-1



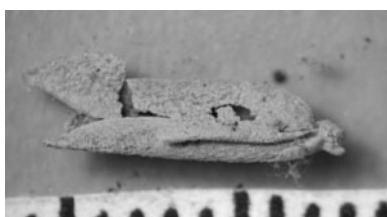
Canarium spp.
Niah



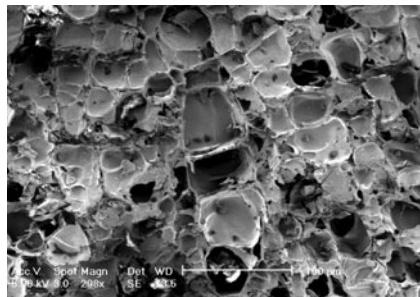
Prob. *Beilschimiedia* sp.
Leang Burung-1



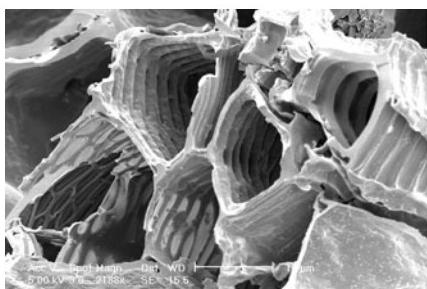
Dracontomelon dao
Madai



Oryza sativa (mineralized spikelet of rice)
Ulu Leang



Dioscorea hispida (wild yam)
Madai



Dioscorea alata (yam)
Madai

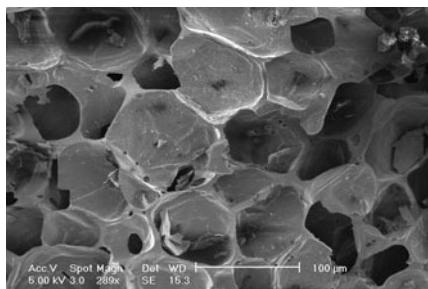


Fig. 3.6. Food-plant remains from prehistoric sites in Island South-East Asia; the three larger images are microscope photographs of plant tissue or parenchyma (photographs kindly provided by Victor Paz)

the ways described above. For many decades knowledge of the early history of the critical staples for many tropical farmers such as yams, cassava, and sweet potato lagged far behind that of the seed crops (Alexander and Coursey, 1969; Shaw, 1977). Pollen seemed to offer the only likely means of identifying the presence of these crops. The first breakthrough came with the discovery that plant phytoliths could be found in sediments, artefact surfaces, and pottery fillers (Pearsall and Trimble, 1984). Because they are specific to different parts of plants, phytoliths can be used to differentiate between wild and domestic plants, and sometimes to inform on the conditions in which a plant was grown. The second advance has been the realization that the parenchyma (soft tissues) of root and tuber crops can also survive in carbonized form and can be identified to family or even species under a scanning electron microscope (Hather, 1992, 2000; Hather and Kirch, 1991; Fig. 3.6). Thirdly, individual starch grains of tubers such as yam and taro are now known to be able to survive for many thousands of years within archaeological sediments and as residues on the edges of stone tools, a discovery that is transforming the study of foraging and early farming systems in tropical environments (Barton and White, 1993; Loy *et al.*, 1992; Piperno *et al.*, 2000; Torrence and Barton, 2006; Fig. 3.7).

A critical focus of archaeobotanical research has been the study of the differences between modern domesticates and their assumed wild progenitors. A domestic species is, essentially, one that has been manipulated to be so different from the wild form that it cannot survive in the wild. By studying differences between wild and domestic forms today, botanists can develop theories about the changes, both observable (morphological or phenotypic) and genetic, that would have taken place en route to domestication as plants

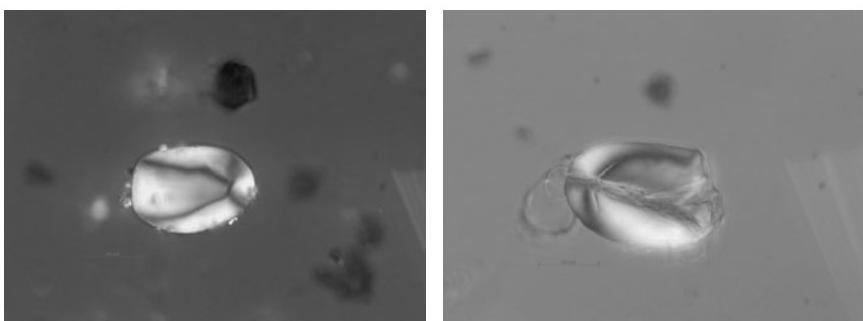


Fig. 3.7. c.40,000-year-old starch grains of (right) sago palm (*Eugeissoa utilis*) and (left) yam (*Dioscorea alata*) from Niah Cave, Sarawak (photographs kindly provided by Huw Barton)

were increasingly separated from their natural populations and their progenies selected for further breeding. One typical difference between domestic and wild forms of a plant is that in the former the seeds cluster tightly to form a head, whereas in the latter they are generally distributed more widely. Presumably the seeds nearer the stem would have been preferentially collected (not necessarily intentionally, of course) by people harvesting wild plants, and outlying seeds missed or knocked to the ground, favouring the development of compacted heads. Another feature of many domestic plants is a strengthened mechanism to retain the seeds on the plant until harvest, like the tough rachis of the wheats and barleys, which again can be understood as something that would develop through the selective process of harvesting. The protective coatings round the seeds also differ: wild seeds need thick coats to survive being dormant in the ground for many months, whereas cultivated seeds are stored and then planted, so do not need such protection. Cultivated seeds are invariably larger than their wild counterparts: whilst humans select for large seeds to give greater food returns per plant, the seeds of domestic plants also need to be larger than those of wild plants, because greater food reserves are needed so that they can start growing quickly when planted. Domestic roots and tubers are generally larger than their wild counterparts. This change is perhaps in part related to the shallower planting depths of the cultivated varieties, though it is possible that selecting for large size might have been a way of dealing with the chemical toxins that many wild forms contain and which have to be removed by a variety of processing procedures before cooking (Johns, 1989).

There is broad agreement about the wild progenitors of seed plants such as wheat, barley, and rice, though the situation is far less clear in the case of most of the roots and tubers such as cassava (manioc), sweet potato, and the yams. There is a need for more intensive taxonomic, biosystematic, and biochemical studies of the wide variety of modern species, and of much more archaeological material to compare with modern material (J. G. Hawkes, 1989). Genetic approaches to plant domestication histories combining studies of modern and ancient DNA, as discussed later in the chapter, hold great promise in this respect.

One of the most important developments in the study of early systems of cultivation has been the recognition that, as well as studying the botanical characteristics of surviving plant remains, archaeobotanists need to recognize the natural and cultural processes that produce the samples they collect, the field of study known as taphonomy (Hastorf, 1988). A pioneering study by Dennell (1972) of carbonized plant remains from Neolithic settlements in Bulgaria demonstrated that some samples were cleaned crops for cooking or storing, others were residues from processes such as threshing and sieving

(to separate the grain from weed seeds and grit). His study stimulated further archaeobotanical fieldwork amongst traditional farming communities in Greece and Turkey (Hillman, 1981; G. E. M. Jones, 1984, 1992, and *et al.*, 1995), to study how crops were grown, harvested, and processed, and how the various products (seeds, chaff, straw) were then used as human or animal feed, for brewing, bedding, thatch, and so on, and what kind of residues were produced by these activities, in order to improve methodologies for the analysis and interpretation of archaeological residues. As a result, archaeobotanists working on the cereal-based crop systems of South-West Asia and Europe have demonstrated how their analyses can inform not just on diet and subsistence but also on cultivation regimes, animal husbandry systems, and economic processes such as specialization, exchange of foodstuffs, and intensification.

Many archaeological sites yield fragments of wood, mostly from the brushwood and timber collected as fuel. They are preserved in the same ways as seeds, by carbonization (most commonly), desiccation, waterlogging, and so on. The species to which a fragment of wood or charcoal belonged can often be identified from its internal structure. The material is studied in much the same way as pollen: the primary information concerns the nature of the woodland from which the wood was taken, but from this it may be possible to make further inferences about human activities (Thompson, 1996). In the developed world, modern forests tend to be either reserved for recreation, or managed for commercial timber production. Most non-industrial farming communities, however, manage their local woodland in a wide variety of ways, including creating woodland grazing, preventing regeneration, collecting dead timber, coppicing, pollarding, and making charcoal, as well as using its produce (nuts, berries, fungi, tubers) to feed themselves and their livestock. The changing history of the human use of woodland is a vital component of the study of transitions to farming, particularly given foragers' and farmers' contrasting notions of it as, at one extreme, a giving environment and, at the other, a hostile wilderness (Chapter 2, pp. 59–60).

ANIMAL BONES AND MOLLUSCS

Unusual conditions of waterlogging and desiccation may sometimes yield intact animals with skin, hair, internal organs, stomach contents, and faecal matter—the frozen mammoths of Siberia, the llamas of the Atacama desert, the Kerma sheep burials of the Sudan desert, and so on. Usually, though, archaeologists just find the bones of animals, either of complete carcasses of animals that had died of disease or had been buried for ritual purposes, or more commonly fragments of butchered bone discarded as food refuse (albeit

frequently bound up in ritual behaviour). Fragments of animal bones are amongst the most common remains surviving on archaeological excavations, being resilient to all but the most acidic soils. Their study began in the last century with veterinarians and zoologists primarily interested in the history of animal species, and they have always been a vital indicator of changing environments in Pleistocene studies. In recent decades, however, the primary focus of their study by most archaeozoologists has shifted from the animals themselves to what the animal bones can tell us about the people who exploited the animals. This shift of interest has been critical to the study of transitions from hunting to herding, and the role of animals in the development of systems of mixed farming.

During the 1960s, as described in Chapter 1, a major impetus for zoological research on the beginnings of farming was the concern to define criteria for recognizing the process of animal domestication in South-West Asia. Principal use was made of size diminution, morphological changes in bones, and changes in herd mortality structures. Regarding size diminution, the general assumption was that either early farmers would have deliberately selected smaller animals that were easier to handle, or that animals would have got smaller because feeding regimes were poor, or both. Clearly size affected many animal species in the Holocene in addition to the animals that were to become domestic livestock, so it cannot be wholly related to human selection (an interesting recent study shows that there was a parallel size reduction in humans, too: Leach, 2003). The experience of a contemporary domestication programme on musk ox was that the bigger animals were the more docile and amenable to management (Wilkinson, 1975). Changes in bone chemistry proposed as an indicator of goat domestication turned out to reflect different soil chemistries of the different samples used (Perkins and Daly, 1968). A morphological change in the shape of cattle, sheep, and goat horn cores is generally accepted as an indicator of the domestication process, though difficult to understand beyond the observation that it must presumably be related either to the relaxation of selective pressures affecting the wild population, or to deliberate human selection over generations. Changes to pig jaws and teeth may in part reflect changing feeding regimes. An increased frequency of young animals in a herd has also been taken as a sign of domestication, of closer management, but unfortunately selective hunting can produce very similar mortality profiles. Much current work in archaeozoology has a focus on improving criteria for recognizing domestication (Vigne *et al.*, 2005).

The realization that the development of animal husbandry needed to be studied as a process rather than as an event put much more emphasis on detailed analyses of entire bone assemblages (Payne, 1972b). The primary

information gathered by archaeozoologists today concerns what animals are represented at a site, in what frequencies (though the goal seems simple, the procedures are in fact very complicated), together with data on the kind of bones represented: numbers of males versus females, frequencies of different age groups (young, mature, old), which parts of their skeletons are unexpectedly common or uncommon, whether there are signs of butchery, injury, and disease, and so on (S. Davis, 1986; Klein and Cruz-Uribe, 1984; T. P. O'Connor, 2000; Reitz and Wing, 1999). Analysis at this level of detail has the potential to provide a rich variety of information about the cultural context of agricultural transitions, not just that hunters or herders ate meat, and what kind of meat. We can learn about which animals people were selecting to kill, how they killed them, how they used the carcass, how they used them in their ritual activities and social relations, and how they thought about them in terms of their ideologies. For example, was communal feasting taking place? Were products other than meat also important, such as milk, or wool, or traction power? Were live animals being kept as wealth on the hoof? Were animals or animal products being exchanged between individuals and/or communities? Migratory birds and fish may also give hints as to the season or seasons of occupation of a site. The application of isotope analysis using the same principles as are described in the next section for human bones can be used to inform on what animals were eating, as in the analysis of dog skeletons from Mesolithic sites in England and Denmark, a study which provided useful insights into the human diet at these settlements because of the likelihood of the dogs scavenging food discarded by people (Clutton-Brock and Noe-Nygaard, 1990), as well as into the seasonality of occupation (Schulting and Richards, 2002a).

In parallel with the methodological developments in archaeobotany discussed earlier, there has been similar taphonomic research to help archaeozoologists recognize the many natural and cultural biases that transform a once-living herd of animals into a pile of bones in the laboratory (Lyman, 1994; Fig. 3.8). Many processes will affect a bone sample, removing some bones entirely, or particular bones of particular kinds of animals (young ones, for example), or particular parts of bones, such as: the methods used to butcher a carcass; the way the carcass is processed for its skin, meat, and bones; the way the remains are thrown away (buried quickly in pits, or left on the ground to be exposed to dogs, trampling feet, and the weather); and the acidity of the soil in which the bones are buried. Though the best analyses carefully consider the possible effects of such biases on the material, the lack of consistency in reporting methodologies can often make it difficult to judge the reliability of published interpretations about the system of hunting or herding at a particular site. What is even rarer is detailed consideration of the context of the

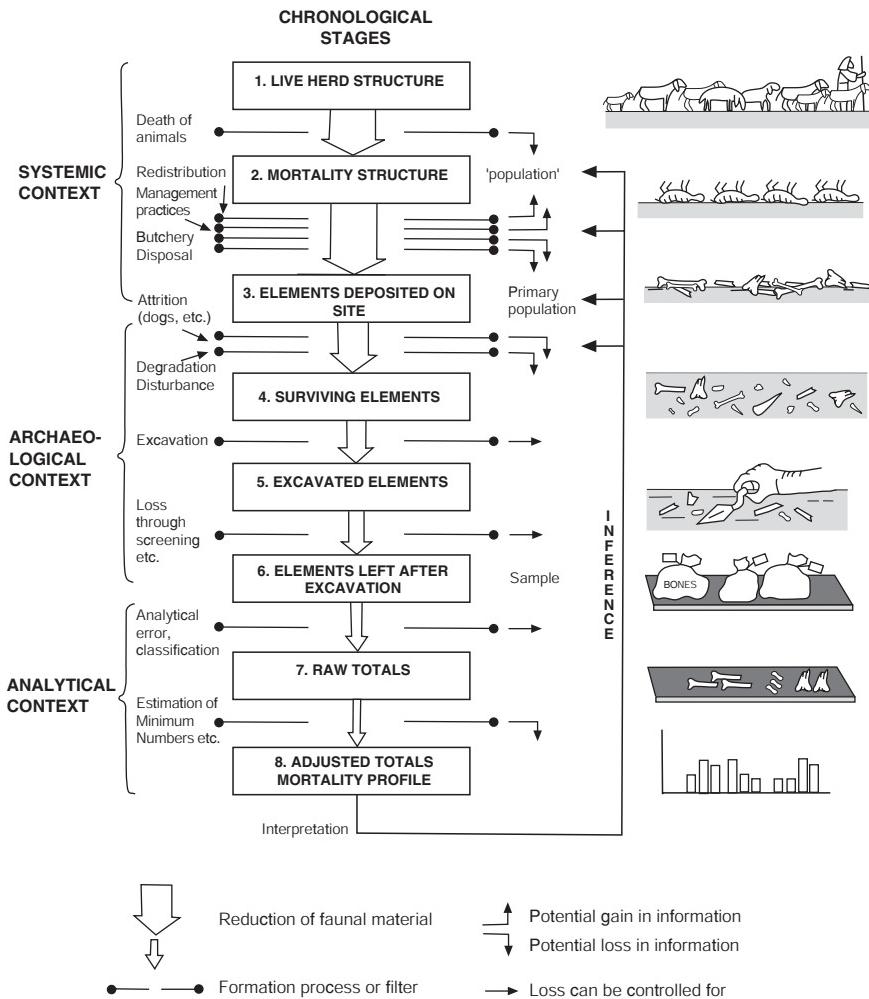


Fig. 3.8. The formation of the archaeological faunal sample: from living animals to a pile of bones in the laboratory (after Cribb, 1985: fig. 3.1)

material within a site: on many excavations the bones from different pits, post-holes, ditches, floor levels, and so on are still lumped together and discussed only in terms of chronological groups ('the bones from Phase 1'). Yet detailed studies of bone distribution at archaeological settlement sites can reveal subtle differences in the food refuse being discarded by different households within the settlement, yielding important insights into the social behaviour of its inhabitants (e.g. Arbogast *et al.*, 1995; Barker, 1988; Halstead *et al.*, 1978), akin

to Hodder's study of contemporary Moro and Mesakin behaviour (Hodder, 1982a; and see Chapter 1, p. 34).

An important methodological development in the study of animal bones was the realization of the importance of sieving sediments to collect reliable samples, reliable in the sense of being a representative sample of the bones surviving in the ground. A pioneering experiment by Payne (1972a) at Sitagroi, a Greek Neolithic site, showed that workmen using picks and shovels only tended to see, and collect, large fragments of bone, whereas when the earth they had shovelled out of the trench was carefully screened or sieved, it became clear that they had missed very large numbers of small fragments of animal bone. The larger fragments collected by the workmen generally belonged to the larger animals such as cattle, whereas the smaller fragments collected in the sieved samples were dominated by bones of smaller animals such as sheep and goats, along with small numbers of small mammals, rodents, and fish. In other words, pick-and-shovel excavation yielded an image of animal husbandry at Sitagroi dominated by cattle, whereas in fact the most numerous livestock were sheep and goats. The implication was clear, that unless sieving was used by the excavator to screen the soil, the faunal sample was very likely to be unrepresentative of what was in the ground. Sieving is time-consuming and expensive, though, first to sieve the soil samples on the excavations and then (especially) to hand-search the resulting residues for tiny fragments of bone, but unless it is used as a control there is no means of knowing how reliable is the faunal material collected, and therefore how reliable are interpretations drawn from it.

Many recent forager and agricultural societies collect terrestrial molluscs and shellfish, though their importance may vary widely: a critical source of food, an alternative food source, a starvation food, fishing bait, a material for tools and ornaments, and so on. Many prehistoric foragers and early agricultural societies collected shellfish (G. N. Bailey and Parkington, 1988; Grigson and Clutton-Brock, 1983). The species ecology, shell shape, and shell chemistry of marine shellfish can be used as a guide to reconstructing the environment of the shell midden, and the season of collection can be investigated through species demography, growth lines, and oxygen isotope analysis (Claessen, 1993, 1998). Attempts have also been made to estimate the contribution of shellfish to the diet of a community by quantifying the numbers of shells in a midden, converting them into meat weights, and comparing these with food estimates for other sources of plant and animal food based on calculations from the other food remains at the site (Koike, 1986). There are daunting problems, however, quite apart from the difficulties of estimating the size of the midden. What selection processes do the animal, plant, and shell samples represent, and can they be compared as a result?

Were the shellfish collected wholly, partially, or not at all for human consumption? If they were collected for human consumption, were they eaten then, or dried for eating later? A shell midden can be an impressive archaeological monument, but G. N. Bailey (1978) famously estimated that a person needs to eat about 50,000 oysters or 150,000 cockles to get the calorific equivalent of one red deer. However, though the importance of shellfish for some forager communities (of the European Mesolithic, for example) may have been exaggerated in the past, shellfish may sometimes have been a critical starvation food to tide a community over a short but critical season of dearth. Also, the social context of shell-gathering should not be forgotten: ethnographic studies of some Australian forager societies, for example, found that the women particularly enjoyed collecting shellfish because it gave them 'quality time' to be on their own, or gossip with their friends, with their children safe around them but not getting under their feet (Meehan, 1982).

HUMAN REMAINS

Human remains also provide several kinds of critical evidence, both direct and indirect, for whether people were foraging or farming, or combining these activities, including stomach contents, demographics, indicators of nutrition and disease, and stable isotopes. The archaeological record contains some remarkable examples of entire human bodies being preserved in unusual conditions of waterlogging, freezing, or desiccation, such as the Danish bog bodies, the mummies of Egypt and the Chilean and Peruvian deserts, and the tattooed bodies of Scythian warriors preserved in permafrost at Pazyryk. A more recent example is the extraordinary Iceman in the Italian Alps (Barfield, 1994; Fowler, 2000; Höpfel *et al.*, 1992). In some circumstances even soft organs, stomach contents, and faecal matter may be preserved as well as skin and bone (Holden, 1994; Stead *et al.*, 1986). Preserved faecal matter, whether found in bodies or as separate faeces (coprolites), is extremely instructive about an individual's diet and health, for the material extracted from it may include not just undigested food (plant material, fragments of bone, hair, shell, and so on) but also microscopic remains such as pollen, phytoliths, fungal spores, and parasite eggs (A. Jones, 1992; Sobolik, 1990; Fig. 3.5).

The commonest human remains, of course, are bones and teeth, and techniques have been developed by physical anthropologists for calculating the morphology, demography, and health of the living population from which they derived (Hillson, 1999). Through the nineteenth century and first half of the twentieth century, studies concentrated on taking hundreds of measurements, especially from the skull, in an attempt to establish 'racial types'.

Though such an approach has long been abandoned, the use of metrical analysis to establish regional population characteristics, and relating particular skeletal material to such populations, remains an important approach to investigating the population expansions or inter-mixings predicted by theories for the transition to farming in a particular region (Howells, 1973, 1989, 1995). Non-metric variants such as anomalies in skull formation or dentition can also be used in these studies.

Studies of human bones from cemeteries are the primary means of collecting data to model demographic trends on either side of the transition to farming. Understanding such trends is clearly fundamental given the debates over the nature, timing, and scale of population increase in the late Pleistocene and early Holocene, and over whether it was a cause or effect of sedentism and/or farming (Chapter 1, p. 32, and Chapter 10). The basis of any demographic analysis is the identification of males and females, and different age classes. Both of these areas of study are the subject of ongoing research to refine methodologies: sexing children, for example, remains very problematical because the main skeletal differences between the sexes develop after puberty. As with animals, the best ageing data are from stages of teeth eruption and wear (Hillson, 1996), but only broad age estimates can be obtained from most methods of ageing adult bones. Many fragmentary bones, therefore, have to remain 'don't knows' or 'possibles' in terms of sex and age groups. A bone sample from a cemetery is also likely to have been affected by attritional processes such as soil acidity that will have further biased the material, removing or damaging particular bones or parts of bones. The task of reconstructing the demography of a living population from a collection of skeletons, especially the small cemeteries that characterize most late forager and early farming communities, is a daunting challenge.

The health of such populations is also critical, and somewhat easier to identify (Figs 3.9 and 3.10), though extrapolation from individuals to populations remains problematical. Signs of injury will inform on living conditions, including the frequency of violence. Bones may show evidence of joint diseases such as osteoarthritis, and certain infectious diseases such as osteomyelitis, tuberculosis, leprosy, and syphilis. Teeth and jaws reveal much about dental health such the incidence of plaque and caries, and by inference dietary conditions such as the amount of sugar and carbohydrate consumed. Increasing rates of tooth decay and of enamel hypoplasia (variations in the spacing of enamel layers thought to be related to dietary deficiencies, especially vitamin deficiencies at weaning) have been used as signatures for the beginnings of maize farming in eastern North America (M. N. Cohen and Armelagos, 1984; Goodman *et al.*, 1984; Rose *et al.*, 1991) and of wheat and barley farming in Portugal (Lubell *et al.*, 1994).

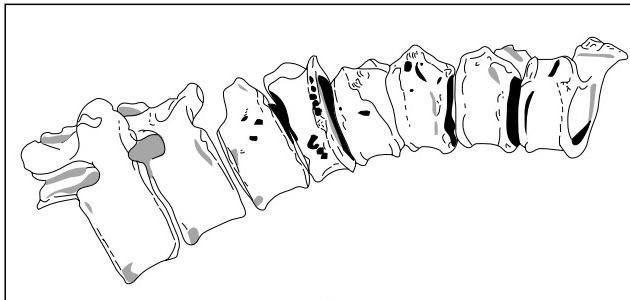
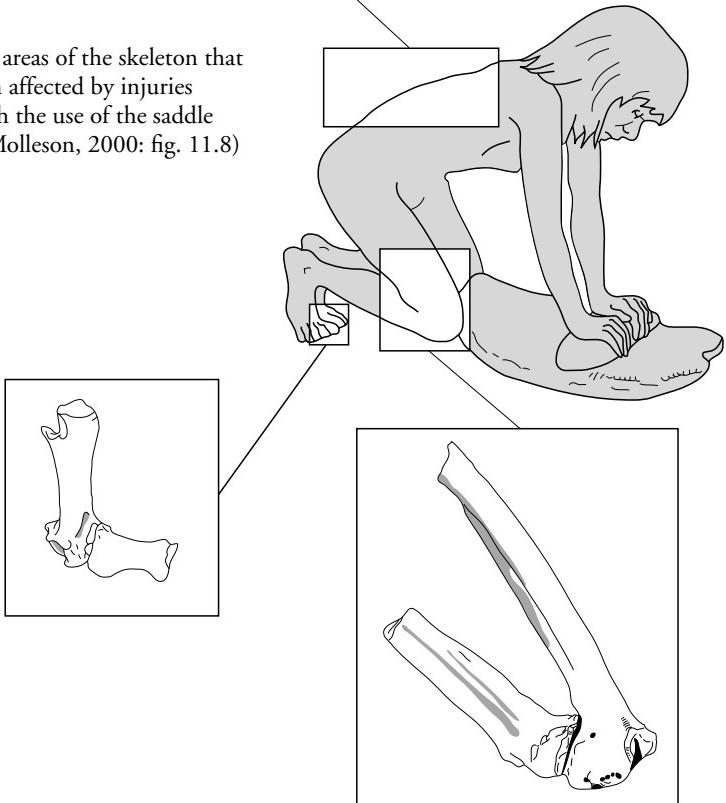


Fig. 3.9. The areas of the skeleton that are most often affected by injuries associated with the use of the saddle quern (after Molleson, 2000: fig. 11.8)



Diets rich in plants, meat, and/or marine foods change the chemistry of our bones, so chemical analysis can be an important indicator of dietary change. Earlier studies of bone chemistry were beset with difficulties caused by the bones absorbing the chemistry of the soils in which they had been buried, but in recent years analyses of stable isotopes have revolutionized the importance of this approach. The ratio of the nitrogen isotopes ^{15}N and



Fig. 3.10. Signs of health, disease, and nutrition in human bone material: (top) a healed trauma, (lower right) osteoarthritis, and (lower left) dental caries (after Hillson, 1999: figs. 7.6–7.8; photographs kindly provided by Simon Hillson)

^{14}N reflects especially the proportion of protein in the diet, so high values reflect meat-eating, with highest values for marine foods, though the ratio may also reflect the proportion of nitrogen-fixing plants in the diet such as legumes. The ratio of the carbon isotopes ^{13}C and ^{12}C is also in part related to the amount of protein in the diet, with marine foods scoring highly again, but the ratio is also a function of warmth and sunshine in plants: plants grown in high temperatures and lots of sunshine such as maize, sorghum, and millet give high values ('C4' plants), and the temperate-climate cereals wheat, barley, and rice give low values ('C3' plants). These ratios can be measured in bone collagen by mass spectrometry (Ambrose, 1993). Nitrogen ratios have been used in North America to measure the change from the consumption of indigenous food plants (C3 types) to a dependence on maize (Schwarcz and Schoeninger, 1991); carbon isotopes in terminal Pleistocene and Neolithic skeletons from Niah Cave in Sarawak (South-East Asia) suggest that the latter were consuming plant foods from more open environments than the former,

perhaps reflecting the opening up of the rainforest for agriculture (Krigbaum 2003); nitrogen and carbon ratios in Mesolithic and Neolithic skeletons from Portugal document the change from a diet of marine and terrestrial foods to a diet more dependent on terrestrial food sources (Lubell *et al.*, 1994).

MODERN AND ANCIENT DNA

Whilst the use of DNA-based methods for identifying, sexing, and estimating relationships between people ('genetic finger-printing') is proving a critical method for forensic archaeologists dealing with skeletal material a few decades or a century old, two kinds of DNA analysis are contributing importantly to the study of the beginnings of farming (Jobling *et al.*, 2004; M. Jones, 2001; Jones and Brown, 2000; Renfrew, 1992). The first—and currently the more significant—is the study of genetic variation in modern populations in order to model the likely genetic pathways that have caused this variation. The increased refinement of molecular phylogenetic techniques is allowing geneticists to make inferences about the origins of domesticates by examining the genetic features of living plants and animals (Fig. 3.11). If a species was domesticated only once, and domesticated members of the species then disseminated, the modern domestic population should display limited genetic diversity compared with wild specimens, given the 'domestication bottleneck' through which the original domesticated population passed. By contrast, greater genetic diversity should indicate that domestication must have taken place more than once, and possibly give hints about on how many occasions. This approach is proving extremely informative, though it is sometimes difficult to separate the objective interpretations of the data from expectations of particular kinds of patterning in relation to current archaeological models. However that may be, the studies of modern genetic patterning currently suggest that: some of the ancient wheats may have been domesticated in Europe as well as in South-West Asia (Brown and Jones, 1996); maize may have been domesticated in a single event in south-western Mexico (Matsuoka *et al.*, 2002; Wang *et al.*, 1999), and the common bean in both Mesoamerica and the Andes (Chacón *et al.*, 2005); cattle were domesticated independently in South-West Asia, India, and probably Africa (Loftus *et al.*, 1994); pigs may have been domesticated several times quite separately across Eurasia (Giuffra *et al.*, 2000; Larson *et al.*, 2005); there were two major domestication pathways for sheep, from two mouflon species (Hiendleder *et al.*, 2002); there were three major domestications of goat (Luikart *et al.*, 2001); two of the water buffalo (D. Bradley, 2000); and probably multiple domestications of the horse across the Eurasian steppes (Jansen *et al.*, 2002). Genetic variation in modern

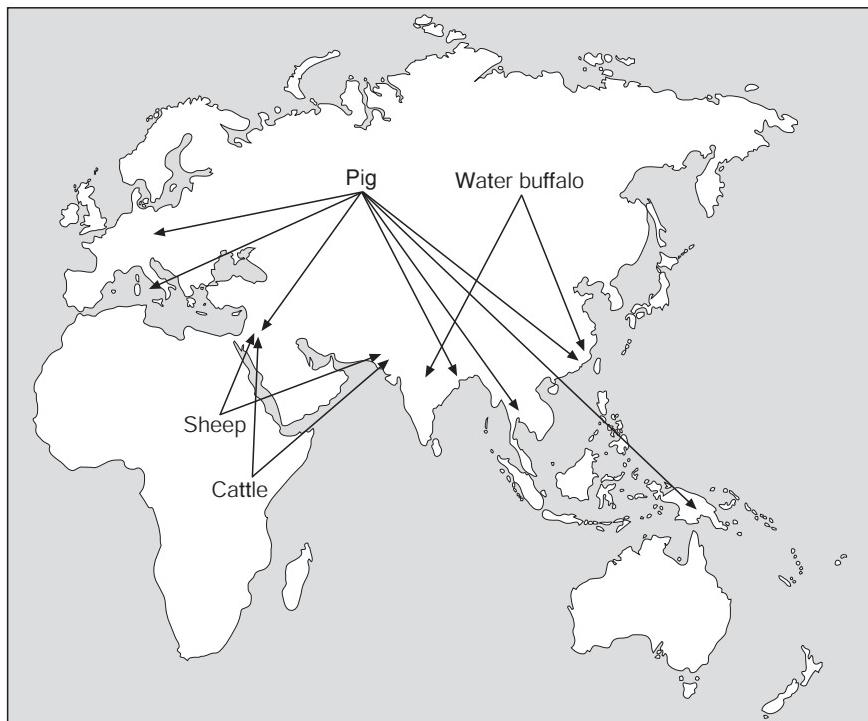


Fig. 3.11. Approximate locations of suggested domestication centres for sheep, cattle, pig, and water buffalo, as suggested by DNA diversity in modern livestock (after D. Bradley, 2000, with additions after Larson *et al.*, 2005)

human populations is also being brought into the domestication debate, though in Europe the results so far have been conflicting (Renfrew and Boyle, 2000), some studies suggesting large-scale human dispersals into Europe in the Neolithic (Cavalli-Sforza, 1996, and *et al.*, 1993), others fixing most population movement in the late Upper Palaeolithic after the Last Glacial Maximum (Richards and Sykes, 1998; Richards *et al.*, 1996, 2000; and see Jobling *et al.*, 2004 for an excellent summary of the current state of the debate). The possible links between the spread of farming and people in South-East Asia are being investigated in the same way, with similarly discrepant and contentious results (Melton *et al.*, 1998; Oppenheimer and Richards, 2001a, 2001b).

The second technique is the study of ancient DNA, made possible through the development in the 1980s of PCR (Polymerase Chain Reaction) sequencing, a technique that generates many copies of a defined part of the base sequence preserved in fragmentary DNA. Most work so far has been on

mitochondrial DNA (mtDNA), given that the chances of usable sequence fragments surviving are so much higher. Early optimism, however, has had to be tempered with the realization of the formidable problems of contamination that need to be resolved, especially by modern human DNA during the extraction of ancient human DNA. Reliable results need to be obtained by two laboratories using the same methods on the same material. However, as well as contributing to the debate concerning the spread of farming across the Pacific (Hagelberg, 1997; Hagelberg and Clegg, 1993), ancient DNA has been extracted from individual seeds of carbonized wheat in Greece, allowing them to be assigned to particular species (T. A. Brown *et al.*, 1999). It has informed on possible pathways of domestication of cattle (C. J. Edwards *et al.*, 2004; Turner *et al.*, 1999) in Africa, South-West Asia, and South Asia, horse in western and eastern Eurasia (Lister *et al.*, 1999), and sorghum in the Nile valley (Deakin *et al.*, 1999). Studies of *Linearbandkeramik* skeletons in central Europe may yield invaluable data on the genetic background of these early farming communities, traditionally identified as the cornerstone of the migration model in temperate Europe (Haak *et al.*, 2005; Sykes and Hedges, 1998).

ICONOGRAPHY AND CEREMONIAL MONUMENTS

The representation of experience through art is one of the defining characteristics of our species, and the archaeological record of many late forager and early agricultural societies is replete with iconography. Such material is probably the richest source of information prehistoric societies have left us that has the potential to offer clues about how they thought about their world and their place within it. It can give us insights into relations between people, animals, and plants that we might not expect from our own notions of nature and culture, wild and domestic. One example of this, though of a later date, is the famous illustration from an Egyptian tomb at Saqqara dated to c.2500 BC showing gazelle, addax, ibex, and oryx with collars and leads, with some eating out of troughs, whilst another part of the same illustration shows striped hyenas being tied and forcibly fed (Zeuner, 1963: 434; another example of this is illustrated as Fig. 10.1). However, whilst prehistoric artists drew from their life experiences, we must not fall into the trap of dividing their material into, on the one hand, what look to us to be familiar representations of 'everyday life', such as scenes of hunting, herding, and ploughing, and on the other, the unfamiliar, to be separated off as 'symbolic' or 'ritual'. Studies of art systems produced by people such as the Australian Aborigines and Kalahari San show how virtually all their art is produced in the context (and as one component) of elaborate ritual behaviour; much of it is produced after dreams

and trances, sometimes drug-induced (Lewis-Williams, 1983; Lewis-Williams and Dowson, 1990).

The best-known iconography produced by prehistoric foragers is the cave art of the European Upper Palaeolithic, though art was also produced by contemporary Pleistocene populations elsewhere (Lewis-Williams, 2002). There is evidence for elaborate grave-goods and rituals amongst many early Holocene forager societies in South-West Asia and Europe. One of the richest areas for early Holocene cave art is the Sahara, where most of the mountain massifs have yielded incised and painted designs, a mixture of wild animals and herded cattle and sheep (Caligari, 1993; Muzzolini, 1986, 2000; Le Quellec, 1987; Fig. 3.12). One of the fascinations of the Saharan rock art is that much of it was probably produced during the period when the population there was changing from hunting, fishing, and gathering to pastoralism (Chapter 8, pp. 301–4).

A few prehistoric forager societies, and many early farming societies, made elaborate ceremonial monuments that have survived in the archaeological record, sometimes for the burial of the dead, sometimes not. The monuments of Neolithic Europe have been intensively studied, and interpreted variously as symbols of new ways of thinking about time and space, spirits and ancestors, territory and landscape, the wild and the domestic (e.g. R. Bradley, 1993, 1998, 2000; Edmonds, 1999; Hodder, 1990; Tilley, 1996; J. Thomas, 1991, 1999; Whittle, 1996; and see Chapter 9). One of the most intriguing features of this rich ceremonialism in Europe is that it developed especially in those areas with the strongest evidence that the monuments were made by indigenous foraging populations on becoming (or in the process of becoming) farmers (R. Bradley, 1993; Sherratt, 1990).

LANGUAGE

Between 5,000 and 10,000 languages are spoken in the world today, and over the past two centuries historical linguists have developed classification taxonomies from degrees of similarities and differences between languages. One of the main units recognized is the ‘family’ of related languages such as Amerind, Eskimo-Aleut, Austroasiatic, Indo-Pacific, Khoisan, Nilo-Saharan, Niger-Congo, and Indo-European (Ruhlen, 1987, 1991). The initial development of these language groups has been correlated with the development of farming in three regions of the world in particular: Europe, Africa, and South-East Asia. The details of the arguments will be considered in the appropriate chapters, but it is useful at this stage to highlight their overall similarities.

The Indo-European family was originally defined by Augustus Schleicher in 1863, in recognition of the similarities between a suite of ancient

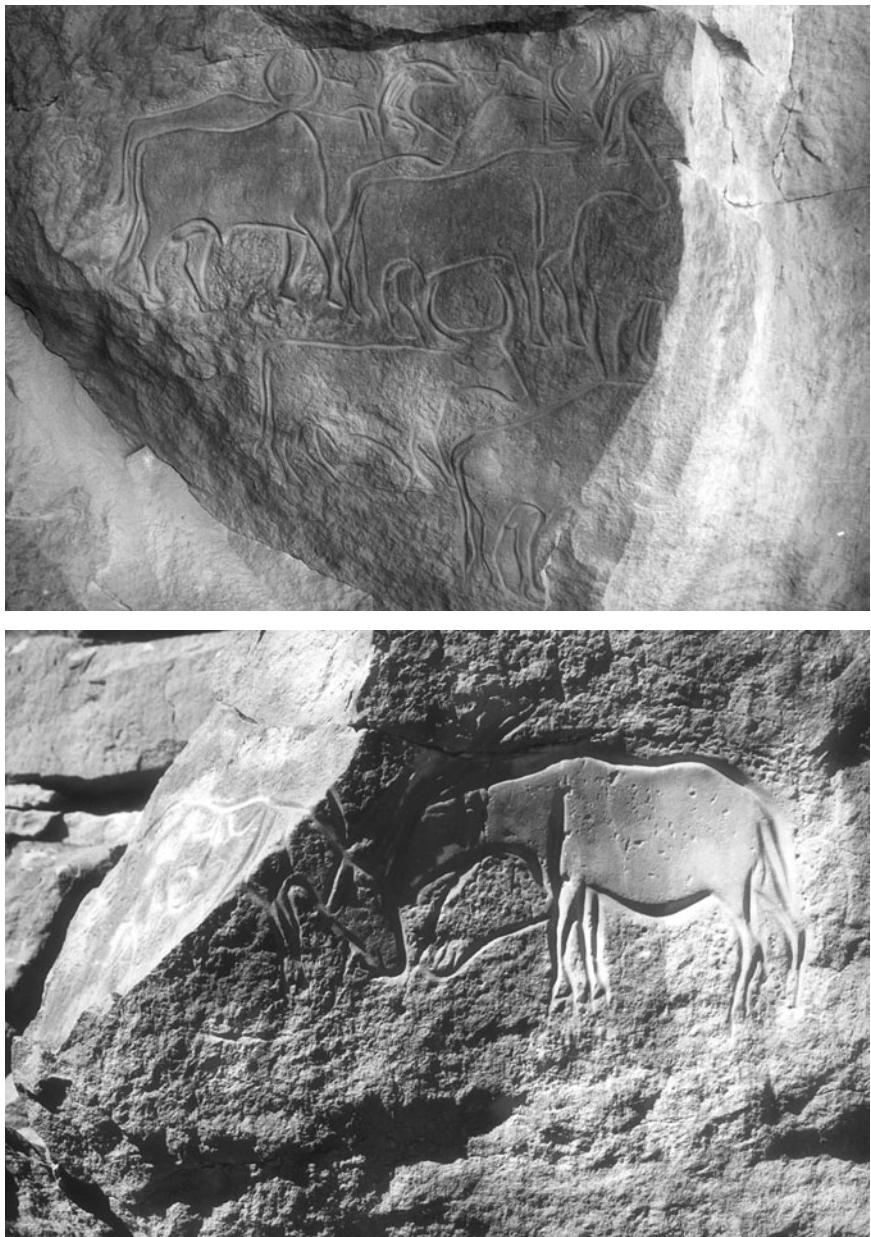


Fig. 3.12. Saharan rock art: engravings of (*above*) domestic cattle and (*below*) domestic sheep in the Messak Settafet, south-west Libya (photographs: Graeme Barker)

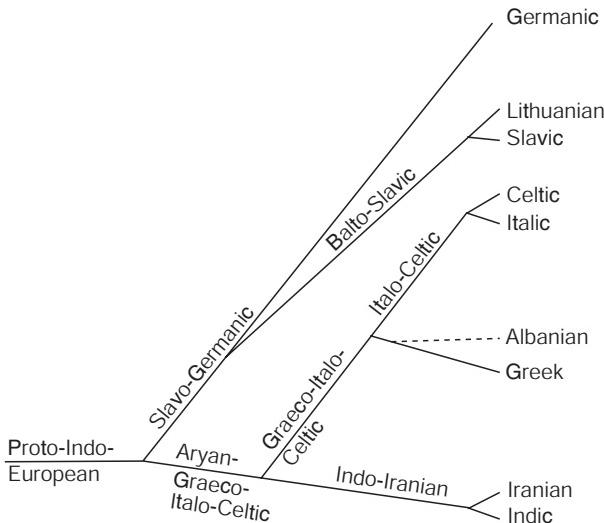


Fig. 3.13. Schleicher's family tree model for the Indo-European languages (after Renfrew, 1987: fig. 5.1)

languages in Europe (Greek, Latin) and South Asia (Sanskrit) and a series of modern languages spoken from the Atlantic to South Asia, including English, French, German, and Spanish in western Europe, the Slavic languages in central Europe, Persian, and the languages of South Asia such as Sindhi, Nepali, Bengali, and Sinhalese. Schleicher argued that the evolution of languages within a family group could be understood on much the same principles as those that were being developed at that time by Charles Darwin to explain the evolution of species. He concluded that the Indo-European family of languages must have evolved from an original core language, 'proto-Indo-European' (Fig. 3.13). It was a short step to the conclusion that the proto-Indo-European language must have been taken to the corners of Europe and Asia by a new people, 'proto-Indo-Europeans'. Over the following hundred years, the arrival of the Indo-Europeans in Europe was identified by archaeologists variously in the Iron Age, Bronze Age, and Late Neolithic (e.g. Gimbutas, 1965), but in each case the thesis was rejected because of stronger evidence for cultural continuity. In 1987, however, Colin Renfrew argued that the most likely candidates for proto-Indo-Europeans were Early Neolithic farmers migrating from South-West Asia into Europe. He was persuaded by linguistic arguments that agricultural terms were present in the postulated core language from very early in its history, and by techniques such as glottochronology suggesting an origin date for proto-Indo-European in Europe very broadly commensurate with the accepted dates based on archaeological evidence for the beginnings of farming.

The second example is sub-Saharan Africa, where for most of the period of study the consensus theory has been that agriculture began because people of a new physical type (Bantu), speaking a new language (Bantu), using a new technology (iron), and a new method of subsistence (farming), spread southwards across the continent. Linguists were agreed that the Bantu languages were part of the Niger-Congo family, but some favoured an area of origin in the north-western part of their present-day distribution, in Cameroon, whereas others argued for a nucleus in the central savannah belt south of the equatorial forest (Greenberg, 1955, 1966; Guthrie, 1962). Both theories were then incorporated into an archaeological model predicting two streams of farmers moving out from the Cameroon centre of origin, one eastwards across the continent and the other southwards to the other proposed centre of origin, the two streams eventually linking together in the far south (Phillipson, 1977a; and see Phillipson, 2002 for a recent reassessment).

The final example is Island South-East Asia, where the majority of modern languages is classified as 'Austronesian'. The linguistic argument here is that 'Proto-Austronesian' was spoken first on Taiwan, the language then splitting into a Formosan and a Malayo-Polynesian stream, the latter splitting again into successive sub-groups (Blust, 1988). Peter Bellwood in particular has argued for an archaeological correlation between the assumed spread of the Austronesian language with the spread of farming (Bellwood, 1985, 1988, 1990, 1996a, 1996b, 2001; see also Spriggs, 1989): that the distribution of the Austronesian language family derives from the fact that proto-Austronesian-speaking Neolithic farmers took agriculture from the Chinese mainland via Taiwan southwards across the Philippines and Borneo to Indonesia (what has sometimes been referred to as the 'Express Train' model).

In all three regions, as the relevant chapters describe, alongside continued restatements of the language/demic diffusion models alternative arguments are also being proposed to explain the transitions to farming, involving internal changes amongst the indigenous forager populations. If correct, as discussed in Chapter 10, such theories imply the need for alternative models of language development to explain the undoubtedly linkages between members of language groups and the presence of agricultural terms at an early stage in their development.

CONCLUSION

As this and the previous chapter have demonstrated, the study of why foragers became farmers necessarily involves a very broad-based archaeological methodology across its full spectrum from archaeological science to social

approaches, along with a large number of other disciplines in the sciences, social sciences, and humanities. No one sub-set of archaeology or other discipline on its own can possibly attempt to resolve the complex range of questions that the ‘agricultural revolution’ poses for us. In any particular region, what was the environmental context of the transition, in terms of both overall climate and the local environment in which people were living? What animals and plants were being used by people as foragers and by people as farmers? How were they being exploited through time? What were the nature and scale of subsistence change, its rapidity, or slowness? How unidirectional was it? (That is, did foragers who became farmers always remain so?) What forms of settlement and territorial behaviour were associated with people’s subsistence activities before, during, and after they moved from foraging to farming? What population levels were associated with the same timescale? What social structures? How did diet change, and health? How wide were people’s social networks bringing them in contact with other foraging and/or farming societies? How were the world-views of foragers transformed into those of farmers—how did people perceive the world they lived in and their relations to it, and how did those perceptions shape the decisions they took? If environmental, and/or demographic, and/or social changes appear to provide a context in which a foraging society developed a commitment to farming, how did that society perceive the risks and opportunities presented by such changes? What options were available for them to respond to such changes, and if we can identify the choices they made, can we understand them from their perspective as opposed to with the benefit of hindsight?

The study of why people became farmers has been pursued mostly either at the level of global generalizations, or through locally specific case studies (though often implied to be widely relevant), or using a particular methodological technique or theoretical perspective. However, it is clear that we need to integrate the full range of methodologies described in this chapter to construct regional histories of foraging–farming transitions on a global basis if we are to attempt to discern general answers to the complex questions about the agricultural revolution posed above. The following six chapters therefore review the disparate evidence for transitions from foraging to farming region by region, beginning with South-West Asia as the assumed first ‘hearth of domestication’ (Chapter 4), then moving eastwards across Central, South, East, and South-East Asia (Chapters 5 and 6), across to the Americas (Chapter 7), back to Africa (Chapter 8), and north to Europe (Chapter 9), before drawing the material together in a concluding assessment of why prehistoric foragers became farmers.

4

The ‘Hearth of Domestication’? Transitions to Farming in South-West Asia

INTRODUCTION

The principal focus of this chapter is the classic zone of early farming research from the 1960s onwards, the so-called ‘hilly flanks of the Fertile Crescent’ in South-West Asia (Fig. 4.1). This region is normally defined as the arc of hill country to the west of the Syrian desert and to the north and east of the Tigris and Euphrates valleys. The western side of the arc begins east of the Nile in the Sinai and the Gulf of Arabah on the southern border of Israel and Jordan; it continues northwards as the hill country on either side of the Jordan rift valley in Israel, Palestine, Lebanon, western Jordan, and western Syria (the so-called ‘Levantine corridor’); and extends westwards to the Mediterranean littoral. The northern sector is formed by the Taurus mountains along the southern edge of the Anatolian plateau, which curve eastwards from the Mediterranean coast in northern Syria to form the present-day Syrian–Turkish border. The eastern sector consists of the Zagros mountains, running south-eastwards from eastern Turkey and north-west Iran to the Persian Gulf, forming the Iraq–Iran border for most of their length, and continuing in south-west Iran beyond the Persian Gulf towards the Straits of Hormuz. The region also embraces adjacent zones: the alluvial plains of the Tigris and Euphrates rivers and the vast tracts of steppe and desert country separating them from the Levantine, Taurus, and Zagros upland systems; the Anatolian plateau to the north of the Taurus, within modern Turkey; and the Iranian plateau east of the Zagros, within modern Iran. The archaeological literature commonly uses the term Near East to describe the main region of interest, with the Levant for its western side (a term also used in this chapter), and South-West Asia for the eastern side, but the entire region is more correctly termed South-West Asia.

The upland areas of the region mostly receive more than 200 millimetres of rainfall a year, which is the minimum required for growing cereals without

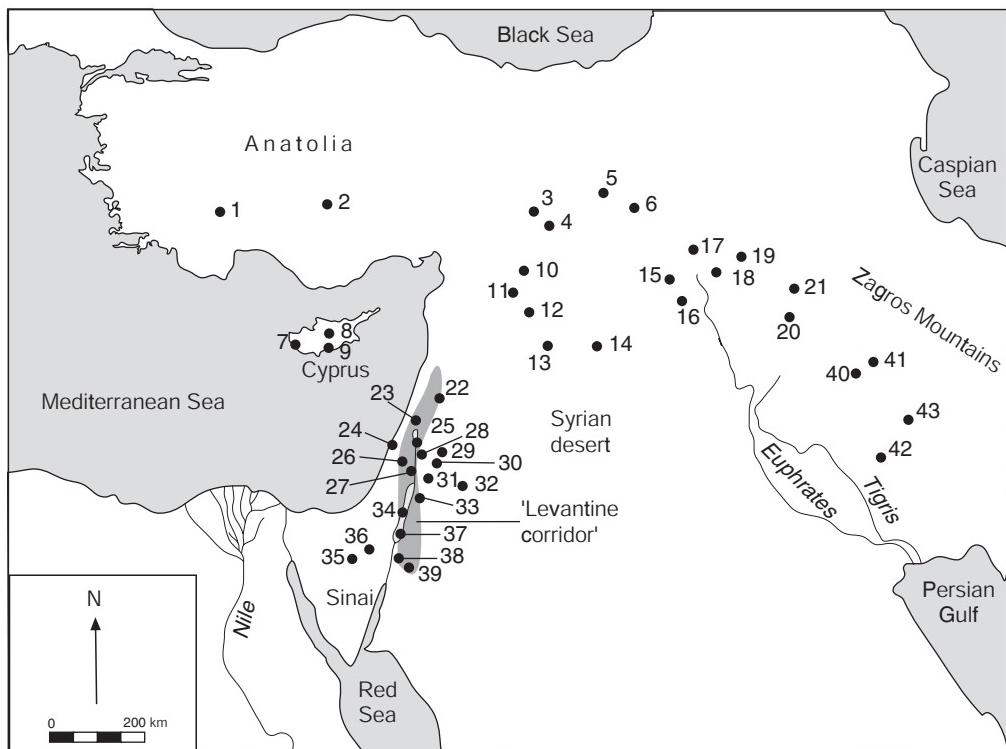


Fig. 4.1. South-West Asia: principal sites and regions mentioned in Chapter 4 (and the Cypriot sites discussed in Chapter 9)

Sites: 1. Haçilar; 2. Çatalhöyük; 3. Grittle; 4. Göbekli Tepe; 5. Çayönü Tepesi; 6. Hallan Çemi; 7. Mylouthkia; 8. Aetokremnos; 9. Shillourokambos; 10. Jerf al-Ahmar; 11. Mureybit; 12. Abu Hureyra; 13. El Kowm; 14. Bouqras; 15. Maghzaliyah; 16. Qermez Dereh; 17. Nemrik; 18. M'lefaat; 19. Shanidar, Zawi Chemi Shanidar; 20. Jarmo; 21. Zarzi; 22. Tell Aswad; 23. 'Ain Mallaha; 24. Mount Carmel—Hayonim, Kebara, Ksar Akil, Mugharesh el Wad, Nahal Oren; 25. Ohalo; 26. Shukbah; 27. Gilgal, Netiv Hagdud; 28. Wadi Hammeh; 29. Taibe; 30. Iraq ed-Dubb; 31. 'Ain Ghazal; 32. Azraq; 33. Dhra'; 34. Nahal Hamar; 35. Rosh Horesha; 36. Rosh Zin; 37. Wadi Faynan; 38. Beidha; 39. Basta; 40. Ganj Dareh; 41. Ghar-i-Khar; 42. Ali Kosh; 43. Pa Sangar

irrigation. Rainfall decreases drastically moving out into the steppe and desert zones. The most forested parts of the region are the northern and southern coasts of Turkey, but lighter oak woodland is found throughout the Levant, Taurus, and Zagros mountains at median elevations, and in western Turkey. Steppe vegetation is found mainly in the central Anatolian plateau and to the south of the Taurus mountains in the upper Tigris and Euphrates valleys.

As I discussed in Chapter 1, the principal reason for the focus of so much field research looking for the origins of agriculture in this region has been the distribution here today, especially within the zone of oak woodland, of

species of wild plants and animals assumed to be the ancestors or progenitors of the domestic plants and animals on which later farming both here and in adjacent regions (Europe to the west, South Asia to the east) has been based: in particular, wheat, barley, sheep, and goats. The wild cereals have been well researched in terms of their modern distributions and genetic affinities with modern and ancient crops, particularly by Harlan and Zohary (Harlan, 1995; Harlan and Zohary, 1966; Zohary, 1969, 1989; Zohary and Hopf, 1988). The principal domestic cereals found on Neolithic sites in South-West Asia are einkorn and emmer, the so-called primitive wheats, and barley. Zohary's 1989 maps of the modern distributions of wild einkorn, emmer, and barley, the assumed ancient progenitors of these crops, are reproduced as Figure 4.2.

One of the problems of the mapping programmes is that most of the botanical fieldwork has concentrated in the 'hilly flanks' zone, so it is not always clear whether the areas of 'densest finds' reflect actual densities or are in part a product of fieldwork bias. Wild einkorn (*Triticum boeoticum*), assumed to be the ancestor of cultivated einkorn (*Triticum monococcum*), has been found most commonly in Turkey and the Zagros mountains, though there are many outliers in the Balkans and others in the Levant. Wild barley (*Hordeum spontaneum*), assumed to be the ancestor of cultivated barley (*Hordeum vulgare*), has been found especially in the 'hilly flanks' arc of the Levantine, Taurus, and Zagros mountains, but its distribution also extends over 1,000 kilometres westwards from the Levant to Crete and eastern Libya and over 3,000 kilometres eastwards across the uplands of Iran and Afghanistan to the Himalayas and Tibet. There are two species of wild emmer but only one, *Triticum dicoccoides*, is chromosomally identical and fully interfertile with the tetraploid cultivated wheats and is therefore identified as the ancestor of cultivated emmer, *Triticum dicoccum*. It has been found mainly in the Levantine, Taurus, and Zagros mountains (the other, *Triticum araraticum*, is found mainly in the Zagros). Legumes such as peas and lentils are widely distributed from the western Mediterranean to the Caspian Sea (Ladizinsky, 1989).

The traditional view is that the domestic sheep (*Ovis aries*) is descended from the wild Urial or Asiatic mouflon sheep *Ovis orientalis*, which is found widely distributed all the way from the eastern Mediterranean to the edge of the Himalayas; and that the domestic goat (*Capra hircus*) is descended from the wild bezoar goat *Capra hircus aegagrus*, which is distributed from Turkey south-east down the Zagros to Baluchistan (west Pakistan) and eastwards beyond the Caspian Sea into central Asia. Wild cattle or aurochs (*Bos primigenius*), the ancestor of both the European domestic *Bos taurus* and the Indian humped or zebu cow *Bos indicus*, was distributed in the Pleistocene right across Eurasia from the Atlantic to the Pacific, as was the wild pig *Sus scrofa*, the ancestor of the domestic pig.

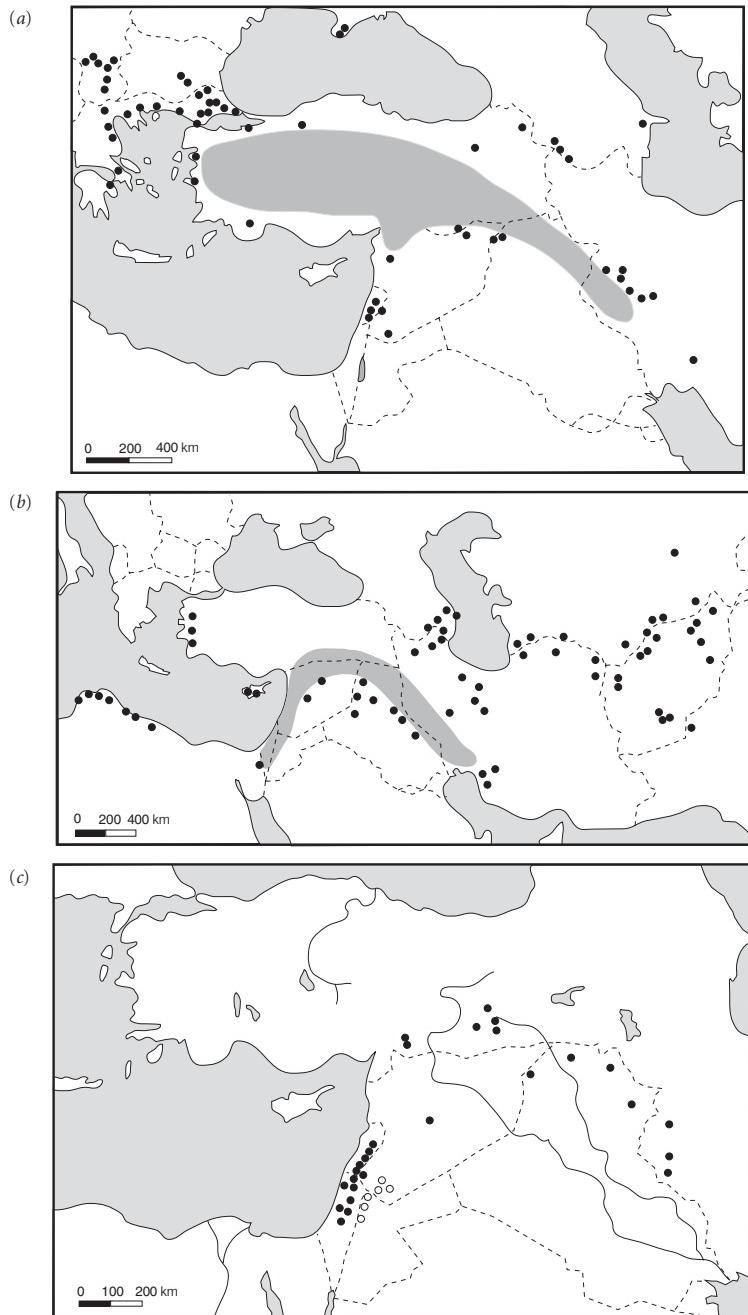


Fig. 4.2. Distributions of modern wild cereals: (a) wild einkorn (*Triticum boeoticum*), (b) wild barley (*Hordeum spontaneum*), and (c) wild emmer (*Triticum dicoccoides*); shading shows massive stands, dots more isolated populations (usually of weedy forms); the barley distribution extends off the map to the east as far as Tibet; the emmer map distinguishes between sites of plants tested cytogenetically (closed circles) and those of sites untested but presumed to be *dicoccoides* (open circles) (after Zohary, 1989: figs. 22.1, 22.2, and 22.3)

In the case of both the cereals and the domestic stock, therefore, whilst the presumed wild ancestors are certainly found in the ‘hilly flanks’ areas of South-West Asia across an area measuring some 1,500 kilometres at the furthest extent of the arc from west to east, their modern distributions in fact extend considerably further to the west and east, in some cases by two or three times that distance. In using DNA fingerprinting on einkorn and emmer (respectively) to try to identify where they might have been domesticated, Heun *et al.* (1997) and Özkan *et al.* (2002) assumed that their current biogeographical ranges must encompass the location of their domestication (which they fixed to the Karacadağ mountains of south-eastern Turkey), yet as G. E. M. Jones *et al.* (1998) point out, we might expect domestication to have greater value at the edge of a species distribution, or outside its range, than at its core. Some of the presumed ancestral species may not even be ancestral anyway: the relationships between the modern wild populations of sheep and goats are much less clear than those between the wild and domestic cereals, for example, and some populations may well be feral, once-domestic stock that escaped and reverted to the wild.

Hence, whilst this chapter concerns itself with the area classically defined as the place where farming first began in the Old World, it is important to recognize the dangers of circularity: farming has been presumed to have been earliest here, so most research has taken place here. Indeed, in recent decades political considerations have meant that relevant research in South-West Asia has been even further concentrated within a very few locations such as the Jordan valley and its environs in Israel and Jordan, the Syrian steppes, and central and western Turkey, with the Lebanon (until very recently), the West Bank and Gaza, eastern Turkey, Iraq, and Iran effectively closed to fieldwork. Yet as Bender (1975: 106) pointed out almost thirty years ago, ‘one can accept that there is an important centre in South-West Asia where many potential domesticates exist, but to confine the search to this centre may distort the attempt to understand the processes involved in the gradual shift to food production’. If archaeologists researching the beginnings of the Eurasian system of mixed farming (the mix using wheat, barley, sheep, and goats, as well as legumes, cattle, pigs, and so on) had really followed their oft-stated logic of following the modern distributions of the supposed ancestral populations, they should have been working equally from the eastern Mediterranean to the Himalayas. Indeed, as the next chapter makes clear, the evidence from Central and South Asia is providing intriguing indicators that transitions to farming there may also be of great antiquity. We need to approach the evidence for the beginnings of cereal and sheep/goat farming, therefore, in the knowledge that most of the best evidence comes from a few ‘hot spots’ of active research in South-West Asia.

The final introductory point to make concerns chronological confusions. Virtually no two 14C chronological tables published for the periods of pre-history thought to encompass the transition to farming in South-West Asia are the same, being based (though not always transparently) variously on uncalibrated dates BP (Before the Present), calibrated dates BP, uncalibrated dates BC, or calibrated dates BC. Also, whereas calibration usually adds about a thousand years to 14C dates several thousand years old, the marine carbonate curve now suggests that we need to add nearer two thousand years to radiocarbon determinations earlier than 10,000 BP, and perhaps three thousand years or more to dates over 12,000 BP (Sherratt, 1997: 271–2). However, this has only emerged relatively recently, so calibrated chronologies published before are invariably too young. The confusion in dates is particularly problematical given the abundant evidence for major climatic oscillations at the Pleistocene–Holocene transition, and resulting arguments about whether or not particular oscillations were contemporary with, and related (or not) to, changes in human behaviour. Such debates are further complicated by disagreements over the timing and nature of environmental changes in response to climatic changes, and the extent to which different parts of South-West Asia were affected by them. In the following discussion I have used the ‘older’ absolute chronology proposed by Sherratt (1997).

KEBARAN AND ZARZIAN FORAGERS, c.20,000–13,000 BC

During the Last Glacial Maximum c.20,000 years ago, atmospheric circulation belts were at lower latitudes than today. The prevailing winter storm path crossed South-West Asia from the Nile delta to the Straits of Hormuz, whereas now it crosses northern Turkey and northern Iran. Beyond the Sinai, the climate of the entire region was extremely cold and dry. Most of the landscape consisted of steppe or desert-steppe, and woodland survived mainly in the uplands of the Mediterranean and Caspian Sea littorals and as isolated stands in the Zagros (Baruch and Bottema, 1991; van Zeist and Bottema, 1991). Sea-level lowering meant that the Mediterranean coast was extended by some 10–15 kilometres from its present location, whilst much of the Jordan valley below about 200 metres below present sea level was covered by what has been termed the Lisan Lake. Plant food resources for human consumption (that included stands of wild wheat and barley) were richest in the woodland areas, though the steppe offered a wide if sparsely distributed range of root tubers and seeds (Hillman, 1996; Table 4.1). The principal game consisted of gazelle and onager in the Levant and Zagros uplands and steppes, together with ibex and goat, with sheep in the northern and eastern steppes and mountains.

Table 4.1. Plant foods available in South-West Asia before and after
15,000 bp

	Before 15,000 bp	After 15,000 bp
<i>Root foods</i>		
Barley grass bulbs	x	X
Cream-flowered cranesbill	x	X
Giant broomrapes	x	X
Grape hyacinths	x	X
Hairy storksbill	x	X
Tatar lily	x	X
Truffles	x	X
Wild crocuses	x	X
Wild parsnips	x	X
Wild salsify (several species)	x	X
<i>Seed foods</i>		
Chenopods	X	x
Colocynth melon	x	X
Crucifers (mustards)	x	X
Fenugreek	x	X
Joint-pine	x	X
Poppies	x	X
Sainfoins	x	X
Spiney caper bush	x	X
Storksbills	x	X
Wall barleys	x	X
Wild cereals (einkorn, barley, rye)	—	X
Wild grasses (e.g. feather grass)	x	X
Wormwoods	X	x
<i>Woodland foods</i>		
Acorns	x	X
Almonds	x	X
Hawthorn fruits	x	X
Syrian pear	x	X
Terebinth nutlets	—	X

Note: x = present; X = common.

Source: Information taken from Hillman, 1996.

There were also wild cattle, fallow deer, roe deer, and wild boar in better-watered and forested places, as well as smaller game such as hare. The Upper Palaeolithic foraging populations of South-West Asia inhabiting these landscapes have been termed Kebaran in the west and Zarzian in the east.

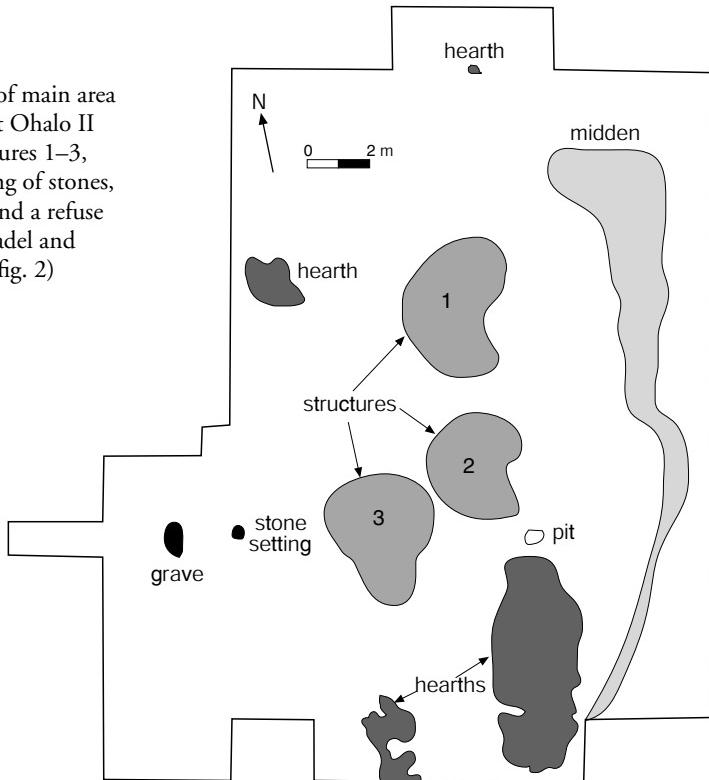
The Kebaran was first defined by Dorothy Garrod following her excavations in 1931 in the Kebara Cave in Mount Carmel, in modern Israel. Kebaran sites are found throughout the Levant from the Mediterranean coast to the steppe-deserts of Jordan and Syria, though most are in the higher rainfall regions.

Most of the sites consist of surface collections of artefacts, of varying sizes. Some are extremely small (25 m^2 or less), most are $100\text{--}150\text{ m}^2$, and a few are much larger ($500\text{--}1,500\text{ m}^2$). Henry (1989: 144) estimated populations of about fifteen people for the majority of sites, with two or three times that number at the largest sites. The small sites, found especially on the steppes, have assemblages dominated by rectangular geometric microliths. The coastal, Jordan valley, and upland sites are generally larger and have more varied assemblages including other microlith forms, blades, and bladelets (Bar-Yosef and Belfer-Cohen, 1992). The latter also tend to have more grinding equipment including small hammer-stones and grinding slabs, but Kebaran sites have produced the first mortars (stone bowls and 'cup-holes'—boulders with pecked depressions) and pestles (Wright, 1994; Fig. 4.4). Presumably the heavier equipment was normally cached at a site for use when the site was revisited rather than carried around: a basalt mortar at the site of Hefsibah, for example, would have weighed almost 20 kilograms when complete, and the nearest source of basalt is some 15–20 kilometres away (Henry, 1989: 159).

The assumption is that most of the upland and steppe Kebaran sites are the campsites of small, highly mobile, bands of foragers, though the balance between hunting and gathering is unclear. The microlithic trapeze rectangles could have been hafted either as arrow tips or sickle blades, but microwear studies indicate that they were more commonly used as arrowheads (Henry, 1989: 163). Faunal samples are rare, but tend to indicate hunting systems geared to particular species at particular sites: gazelle at En Gev I, Kebara, and Nahal Oren, for example, goat at Wadi Madamagh, and fallow deer at Ksar Akil (Moore, 1982). A few sites have produced plant remains in small quantities: wild cereals, legumes, and fruits in the Mediterranean zone, and steppe species to the east (Garrard *et al.*, 1988), though strontium/calcium ratios in human skeletons indicate that Kebarans ate less plant food and more meat than later (Natufian) populations (Schoeninger, 1981, 1982).

By far the best information about Kebaran settlement has come from excavations of Ohalo II, a now-submerged site in the Sea of Galilee in the Jordan valley found in 1989 when the level of the lake dropped by several metres (Kislev *et al.*, 1992; Nadel and Werker, 1999; Nadel *et al.*, 1994). The site, which has been dated to *c.*19,000 BP, measured some $1,500\text{ m}^2$, so is an example of one of the largest Kebaran settlements. About a third of the area was excavated, revealing three kidney-shaped structures, the edges of which were delineated by a dark line in the soil composed of charcoal, straw, and vegetable stems presumably marking the walling of some kind of simple huts (Fig. 4.3). The earthen floor of one of them had been renewed three times. Hearths were positioned around the structures, and an alignment of burnt stones covered with ash appears to have been a simple oven—if the identification is correct,

Fig. 4.3. Plan of main area of excavation at Ohalo II showing Structures 1–3, hearths, a setting of stones, a grave, a pit, and a refuse dump (after Nadel and Werker, 1999: fig. 2)



this would be the earliest evidence yet known for food-roasting strategies. Refuse was dumped on the lakeside of the camp. A burial was found on the inland side: a man who had survived to adulthood despite physical disabilities (osteomyelitis of the chest wall, and an atrophied upper arm: Hershkovitz *et al.*, 1993), buried on his back with his legs flexed beneath him and his hands across his chest, with an incised worked bone tool laid underneath his head (Nadel and Hershkovitz, 1991). The refuse pile contained thousands of bones, especially of fish (10–20 cm-long *Cyprinidae*). Twisted fibres preserved in the organic mud of the site are probably remains of the nets and baskets used to catch and store these fish, the clumping of fish bones in the refuse tip suggesting bagged collections. There were also bones of larger animals such as gazelle and deer, small game such as tortoise and hare, waterfowl and other birds, one interpretation of the number of raptor species amongst the latter such as eagles, buzzards, and vultures being that Kebarans may have started to tame them for falconry (Dobney, 2002). In addition, thousands of carbonized plant remains were recovered from the site, mainly grains and

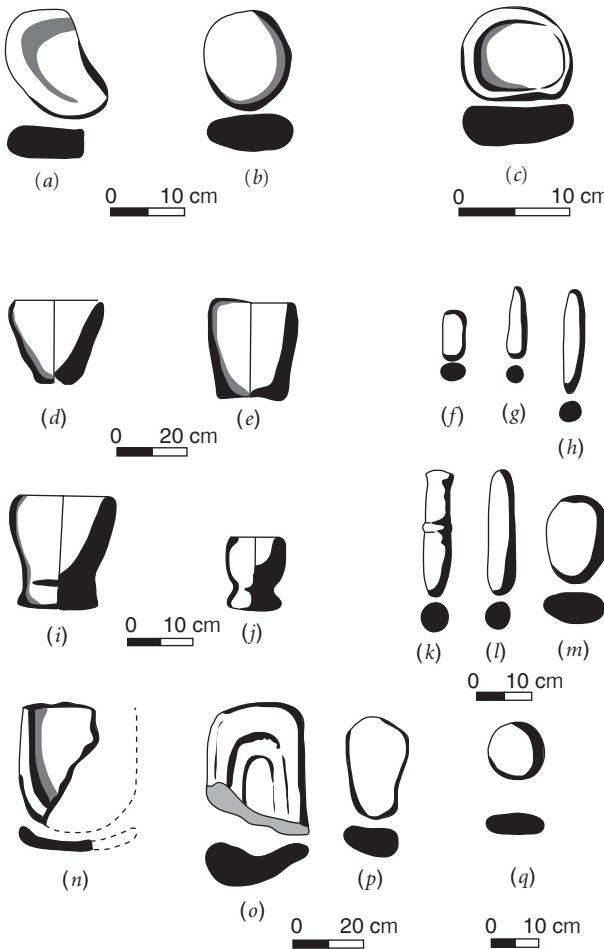


Fig. 4.4. Prehistoric grinding/pounding tools from the Levant. (a–c) Upper Palaeolithic grinding slabs and handstone; (d–h) Kebaran mortars, handstone, and pestles; (i–m) early Natufian mortars, pestles, and handstone; (n) late Natufian grinding slab; (o–q) Neolithic (PPNA) quern, grinding slab, and handstone (after Wright, 1994: fig. 3)

other ear fragments of barley, their brittle rachises indicating that they were morphologically wild. There were also emmer wheat, almond, olive, pistachio, and grapes (all wild forms) and acorns. Starch grains of grass seeds, including barley and possibly wheat, have been recovered from food residues on a grinding stone, the absence of starch grains of roots and tubers (which survive well in such residues) providing useful negative evidence for the importance of seeds in the diet (Piperno *et al.*, 2004).

The indications are, therefore, that these Kebarans were fishing, fowling, and collecting forest foods such as acorns and almonds around the lake, and also gathering wild cereals and other grass seeds and hunting on the steppeland above. The ripening periods of the plant remains suggest that the

grains were being harvested in the spring and the fruits in the late summer and autumn (Table 4.2). Other barley could have been harvested later in the summer in the adjacent uplands such as Mount Hebron, so the conclusion of the excavators is that the Ohalo II community was semi-sedentary, spending most of the year fishing, gathering, and hunting in the Jordan valley, and moving away to higher ground for shorter periods of gathering and hunting.

Although the predominance of a particular animal in Kebaran faunal samples has been used as evidence of possible specialization at this time as a precursor of herding (Legge, 1977), the assemblages could also represent special-purpose hunting sites. The excavators of Ohalo II suggested that the people might have stored foods such as grains to allow them to remain all the year by the Sea of Galilee, but there are no signs of storage facilities at the site (though they postulated the use of baskets). The remaking of the hut floor also suggests seasonal reuse of the site, rather than sedentism. Kebarans were certainly collecting a variety of plant foods, but Wright (1994) emphasizes the very high costs of processing these, especially at a time when they were sparsely distributed over most of the landscape. Combining the evidence suggests that most Kebarans probably practised broad-spectrum systems of hunting, fishing, and gathering, spending most of the year in better-watered and vegetated areas but making seasonal sorties to drier parts of the landscape for hunting and plant gathering. By the close of the Late Glacial they were probably relying increasingly on cereals as a staple food, and adapting their seasonal schedule and patterns of mobility to ensure time to harvest, process—and perhaps store—grain.

Contemporary Zarzian communities (named after the cave of Zarzi in Iraq) in the Zagros mountains are much less understood, principally because much of the area has been closed to archaeological field teams since the late 1960s. Almost all the data derive from cave excavations in the late 1950s and early 1960s, such as Shanidar (Solecki, 1964), Pa Sangar, and Yafteh (Hole and Flannery, 1967). Zarzian lithic technology included blades, bladelets, small scrapers, and geometric microliths much as in the Kebaran, and there are also small coarse grinding stones, but these are thought to have been used mostly for grinding pigments (Hole, 1984: 52). Plant foods were probably much less plentiful than in the Levant (Hillman, 1996). The main ungulates were sheep and goats, goats especially in higher, rockier, places and sheep in lower, gentler, topographies, though their distributions would have overlapped, especially as both probably moved to higher ground in summer and lower ground in winter. However, goat seems to have been the main species hunted by Zarzians, a tradition going back to the Middle Palaeolithic at Shanidar (Evins, 1983), and onager at lower elevations. Other species represented at Zarzian Shanidar included red deer, fallow deer, roe deer, pig, and beaver, waterfowl, river

Table 4.2. Ripening seasons of grains and fruits collected by the Kebaran community at Ohalo II, Sea of Galilee, c.19,000 years ago

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Edible grasses													
<i>Aegilops</i> spp.						x	x						
<i>Avena sterilis</i>	Oat					x	x						
<i>Hordeum spontaneum</i>	Barley					x	x						
<i>Triticum dicoccoides</i>	Emmer					x	x						
Wild fruits													
<i>Amygdalus</i>	Almond						x	x					
<i>Crataegus</i>	Hawthorn							x	x	x			
<i>Olea europaea</i>	Olive								x	x			
<i>Pistacia atlantica</i>	Pistachio						x	x	x				
<i>Quercus</i>	Acorn									x	x		
<i>Vitis vinifera</i>	Grape								x	x			
<i>Ziziphus spina-christi</i>	Christ's thorn					x		x	x	x	x	x	x

Source: Kislev *et al.*, 1992: 164.

clams, and fish. Both sheep and goats were hunted at Ghar-i-Khar (Hesse, 1989). Hole and Flannery (1967) argued for logistical systems of hunting and gathering at this time, with caves such as Shanidar being seasonal base camps supplied by foraging parties using short-duration campsites elsewhere. Little evidence has been produced since to change this model. Though the lack of recent evidence needs to be emphasized, it does seem probable that plant gathering was on a much smaller scale in the Zagros during the Late Glacial than in the Levant, that Zarzian subsistence relied heavily on hunting, and that their territorial behaviour was characterized by marked seasonal mobility.

NATUFIAN FORAGERS AND ?FORAGER-FARMERS, *c.13,000–9500 BC*

The Natufian was discovered by Dorothy Garrod in her 1928 excavations of the cave of Shukbah in Palestine (Garrod, 1942), and further revealed by excavations of sites such as Kebara and Mugharet el Wad in the 1930s. Though there were similarities with the Kebaran in terms of some aspects of lithic technology, the overwhelming impression was of transformations in material culture, with the appearance of houses, elaborate burials, an array of artefacts suggesting plant use (mortars and pestles, sickle blades), and a rich bone technology that included elaborately decorated items. Garrod (1957) concluded that the changes were so striking that Natufians might be an intrusive people, but everybody now agrees that Natufian culture has to be explained as an indigenous phenomenon. In the past the process of cultural development was regarded as gradual (Perrot, 1968), but as a detailed 14C chronology has been established from numerous excavations, it has become clear that the Natufian emerged relatively suddenly throughout the Levant, probably within a few centuries. Though originally regarded as a Holocene phenomenon and therefore termed Mesolithic, the Natufian is now firmly dated to the closing millennia of the Pleistocene. Most authors date its beginning to about 11,000 BC (Bar-Yosef and Belfer-Cohen, 1992; Bar-Yosef and Meadow, 1995; Henry, 1989; Hillman, 1996), but recalibration pushes this back further to nearer 13,000 BC. It is also clear now that there were significant cultural developments within the Natufian, so the evidence is commonly divided into Early and Late Natufian.

The detailed climatic records now available from isotopic analysis of Greenland ice cores demonstrate that the transition from the Pleistocene to the Holocene was not a single and sudden change from colder to warmer climates but a lengthy period of instability, characterized by profound and sudden

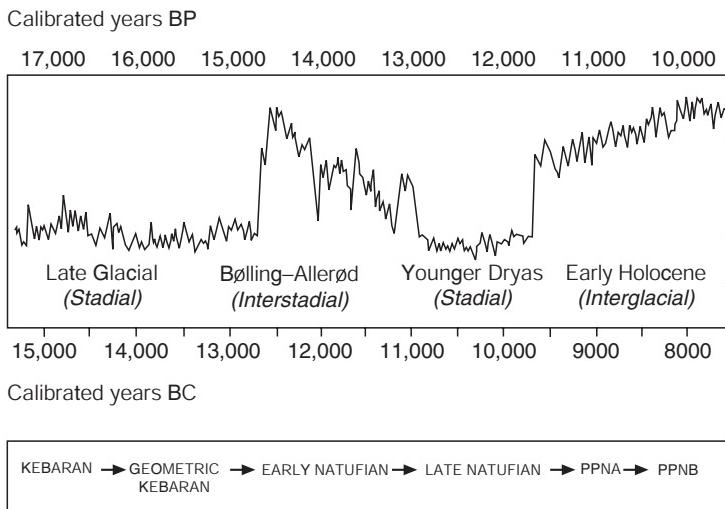


Fig. 4.5. Late Glacial and early Holocene temperature fluctuations according to Greenland ice cores, compared with the Levantine archaeological sequence (after Sherratt, 1997: fig. 1)

temperature fluctuations (Dansgaard *et al.*, 1993). After about 15,000 years ago, there was a sudden dramatic warming in global temperatures marking the beginning of the warmer oscillation termed the Bølling–Allerød interstadial in northern Europe. Temperatures oscillated over the next two thousand years, but the general trend was downwards, back to cold and dry glacial conditions again by c.13,000 BP or 11,000 bc. This colder episode is termed the Younger Dryas stadial. The Early Natufian coincides more or less with the Bølling–Allerød interstadial, the Late Natufian with the Younger Dryas stadial (Fig. 4.5).

Early Natufian Culture

The Bølling–Allerød interstadial brought not only warmer and wetter weather to South-West Asia but also greater seasonality. These changes favoured both deciduous woodland, hitherto restricted largely to the southern Levant and refuges in the Zagros, and annual grasses such as the wild cereals, which had survived the Late Glacial in the better watered parts of the southern Levant such as the Jordan valley (as the Ohalo II site demonstrates). Pollen diagrams indicate that park woodland, a mix of oak woodland and grassland, now expanded rapidly from the southern Levant out over the uplands and steppes

of the northern Fertile Crescent preceded by a 'bow-wave' of annual plants that included the wild cereals (Hillman, 1996). The plant remains from the settlement of Abu Hureyra on the present-day Syrian steppe indicate first that springs and summers at this time in the middle Euphrates valley were moister than hitherto, and second that the inhabitants of the site were gathering plants that included wild einkorn and rye (Moore and Hillman, 1992; Moore *et al.*, 2000). The return of cold and dry conditions in the Younger Dryas caused this park woodland to retreat or thin out, and the cereals with them, the retreat of the forest and its fringe herbaceous plants marked at Abu Hureyra by a decline in tree fruits, asphodels, and cereals. The Holocene climatic warming that began c.9600 BC then allowed park woodland (and the cereals) to expand unabated right across the region as far as the southern Zagros. In the Jordan valley, lake levels rose in the Bølling–Allerød interstadial, fell in the Younger Dryas, and then rose again with the Holocene.

The heartland of Natufian settlement, in terms of the most substantial sites, elaborate material culture, and probably the densest populations, was the better-watered areas of the southern Levant, the Mediterranean littoral, and the Jordan valley, areas with more than 200 millimetres of rainfall today. The area is variously referred to in the archaeological literature as the 'coastal and forest zone' or the 'Levantine corridor'. Presumably there were also many sites on the Mediterranean coast that are now submerged. Many caves were used, but most sites are open-air camps, their sizes varying considerably from under 350 m² to over 5,000 m². Most, though, are 1,000–2,000 m², 5–10 times larger than Kebaran sites (Henry, 1989). Populations of several hundred people have been estimated for the largest sites, but communities of up to about 50 people are indicated more generally.

Stone footings of structures have been excavated at a number of sites such as 'Ain Mallaha, Rosh Zin, and Wadi Hammeh 27, and on the terraced platform in front of Hayonim Cave (Fig. 4.6). These are thought mostly to belong to the Early Natufian. The structures are circular or oval, with post-holes indicating that wooden posts supported simple superstructures of timber and thatch above the stone footings. Foundations of what were probably rather similar shelters were cut into the subsoil at Abu Hureyra (Fig. 4.11) and at Mureybit (30 kilometres from Abu Hureyra), in the latter case made of clay and timber. The structures vary considerably in size from about two to nine metres in diameter. The variable presence of hearths, storage bins, and grinding equipment also suggests that they had different functions in terms of storage, food processing, and consumption. Some may also have been reserved for ceremonial use: the largest structure at Rosh Zin, for example, was the only one at the site paved, and it had a stone phallic structure located prominently within it.

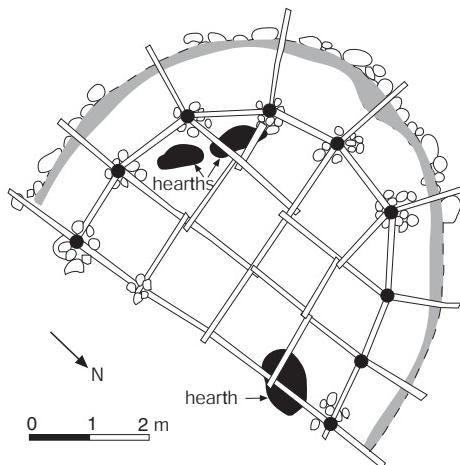
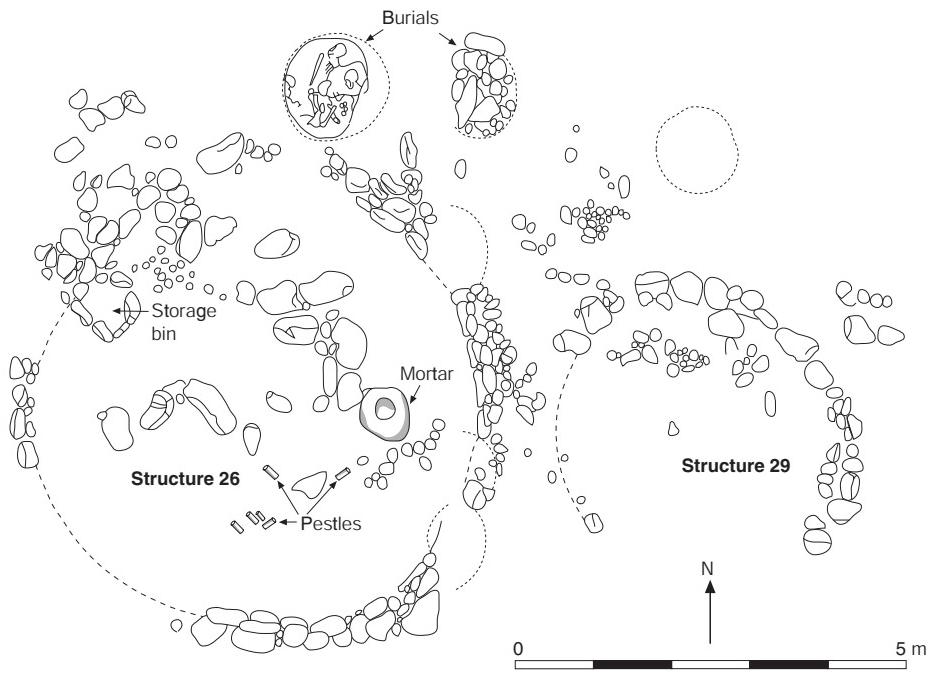
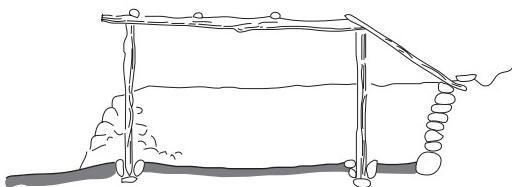


Fig. 4.6. Structures at Natufian 'Ain Mallaha: (above) Structures 26, with mortars, pestles, and storage areas, and 29; note also the external group burial; (left and below) a reconstruction of one of the 'Ain Mallaha dwelling structures (after Henry, 1989: fig. 7.17, redrawn from Perrot, 1966, and reconstruction after Valla, 1988)



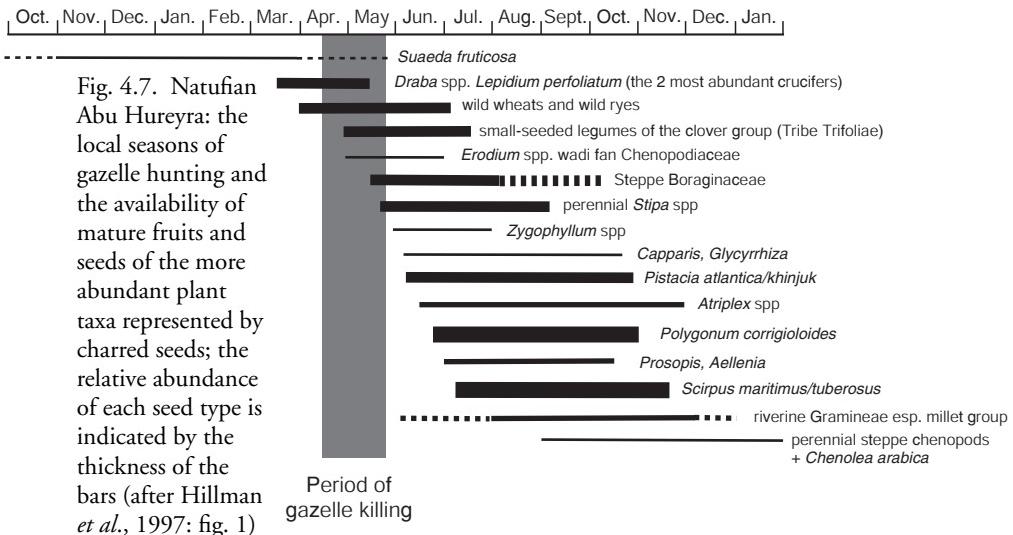
There has been a long-running debate on the subsistence systems practised by Natufians. Were they sedentary or mobile? Did they rely more on plant foods or meat? Did they simply gather wild plants or had they started to cultivate them? Did they hunt gazelle or herd them? One of the main problems in many earlier discussions has been the lumping together of Early and Late Natufian (and thus of adaptations to wetter and drier climates), and of Levantine corridor and steppe settlement. The result is that components of the archaeological record have been selected as typical of the whole, whereas it is clear that both spatially and temporally Natufians were living in widely differing environments and climates and must have adapted accordingly (Bar-Yosef and Belfer-Cohen, 1992; Bar-Yosef and Meadow, 1995; Garrard *et al.*, 1996). Another problem has been the tendency to compare subsistence data from different sites without taking into consideration the fact that similarities and differences might be the result of biases caused by formation processes and collection strategies of the kind discussed in the previous chapter. Thus faunal samples collected by sieving invariably have many more small species represented than those collected by hand. Botanical samples collected at the few sites where water flotation has been used intensively such as Abu Hureyra have produced far more seeds of plants other than cereals, whereas older excavations tended to find only caches of carbonized grain. Also, Miller (1992, 1996) has argued that some seed remains assumed to be human food might in fact have reached the sites in animal (especially gazelle) dung collected for fuel.

In the Early Natufian, favoured locations for the principal settlements of the Levantine corridor were at the junction between lowlands and uplands. Such sites were near to permanent water and presumably fuelwood, and had good access on the one hand to more forested localities where there were nuts, stands of wild cereals, and deer, and on the other, to more open habitats with grassland seeds and gazelle (Byrd, 1989; Henry, 1989). Such settlements were probably occupied for several seasons, though most probably not for the whole year. Studies of cementum bands in gazelle teeth indicate that many sites were multi-seasonal (Liebermann, 1993), and sites such as Hayonim have 'commensal' species (species associated with humans and human settlement) such as the house mouse, house sparrow, and rat. Gazelle usually make up the bulk of the faunal samples at these sites, together with other steppe species such as goats and onagers, though forest species are also well represented such as fallow deer, cattle, red deer, and roe deer. There is also evidence at a few sites for marine and freshwater fish (Desse 1987), and for birds, especially waterfowl (Pichon, 1991). Plant remains include wild barley, wild lentils, wild chick peas, and acorns at Wadi Hammeh 27 (P. C. Edwards *et al.*, 1988), and wild barley, legumes, and almonds at Hayonim (Hopf and Bar-Yosef, 1987). No doubt some of the small sites on adjacent steppes such as in the Negev

and on the Jordanian plateau are campsites used by hunting and/or gathering parties making short sorties to collect the food that sustained these larger settlements. The site of Rosh Horesha, for example, had complete carcasses of gazelle but only selected joints of goat, suggesting longer forays for hunting goats than gazelles (Butler *et al.*, 1977). Presumably people from the main settlements split up into smaller groups for part of the year, camping elsewhere in the corridor or adjacent steppes.

The expansion of park woodland over the steppes also enabled Early Natufians to colonize hitherto-hostile regions such as the Negev desert of Israel, the basalt 'black desert' of eastern Jordan and Syria, and the northern steppes. They were able to establish rather comparable systems of settlement to those of the Levantine corridor at similar ecotonal locations, such as around the edge of the Azraq basin (Garrard *et al.*, 1988), at Taibe in the Kum basin (M. C. Cauvin, 1973, 1974), and at Mureybit and Abu Hureyra (Moore, 1975, 1991; Moore and Hillman, 1992). Wild einkorn, barley, vetch, and seeds of plants such as polygonum were found at Mureybit (van Zeist and Bakker-Heeres, 1984), but intensive flotation yielded over 150 species of plants from the Natufian levels at Abu Hureyra. Hillman *et al.* (1989a) concluded that Natufians at Abu Hureyra were systematically harvesting wild einkorn and barley and over twenty other species (fruits, nuts, legumes, and other seeds) from the steppe and valley, as well as others probably as flavourings, medicines, and dyes. The edible plants were processed using a variety of mortars, pestles, and saddle querns (Fig. 4.4)—the repetitive nature of this labour causing visible wear and tear to a number of joints (Molleson, 1989, 2000)—and roasted in fire pits. The people also hunted a range of game, but concentrated especially on the gazelle. Legge and Rowley-Conwy (1987, 2000) argue from the ages of the animals killed at Abu Hureyra that the community was practising mass kills of herds of gazelle in the spring. The plant remains indicate that the site was occupied from the early spring to the late autumn (Fig. 4.7).

It is possible that Abu Hureyra had to be abandoned in the winter months, but the assumption is that storage of foods collected in the rest of the year, and the collection of roots and tubers, allowed the community to maintain the settlement throughout the year, making the site one of the most convincing as well as earliest examples in the archaeological record of a permanent settlement sustained without agriculture (Hillman, 2000; Hillman *et al.*, 1997). Like the main Levantine corridor settlements, Abu Hureyra was presumably at the hub of a series of short-duration campsites used by hunting and gathering parties leaving the main settlement for a few days. Certainly most sites out on the steppes are very small—those in the Negev are mostly under 100 m² (Goring-Morris, 1987). There were other groups, though, who used the steppes more (Bar-Yosef and Belfer-Cohen, 1992; Byrd, 1989; Kaufman,



1992): the Negev, for example, was probably used in the summer for hunting gazelle and rabbits and harvesting cereals by people who then dispersed to more forested locations at lower elevations where they survived by collecting nuts, gathering seeds, and hunting.

The chipped stone technology of the main Natufian settlements included geometric microliths, broad bladelets, scrapers, and sickle blades, and a few heavier tools. Microwear studies, together with traces of mastic on some flints, indicate that the microliths were hafted as composite arrowheads (Anderson-Gerfaud, 1983). Analysis of Natufian industries indicates that a wide range of activities was practised in the coastal and forest regions, including more plant gathering (more sickles, high frequencies of flint tools other than microliths) than at the steppe sites (Henry, 1989). Some of the latter consist mainly of geometric microliths (hunting stands?), others have more scrapers and denticulates (carcass processing?). The coastal-forest settlements also have far more bone tools, in part no doubt a factor of survival, but not entirely so: burnishers and spatulae for skin working, awls and points for sewing and weaving, plain and barbed points for hunting, gorgets and hooks for fishing, and sickle hafts (Bar-Yosef and Goren, 1973). Grinding equipment is found at all kinds of Natufian sites, but again especially at the main settlements: there is an array of portable mortars, bowls, querns, slabs, grooved stones and pestles, as well as cup stones or bedrock mortars (K. I. Wright, 1994; Fig. 4.4). Some of the latter are almost a metre deep, worn right through and repaired with flint cores (Henry, 1989: 195). It is commonly argued that mortars and pestles

Table 4.3. Percentages of unfused and fused gazelle metapodials at Nahal Oren, Israel

	Number	Unfused	Fused
Kebaran	140	54.4	45.6
Natufian	164	54.7	45.3
Pre-Pottery Neolithic	129	50.3	49.7

Source: Legge, 1972: 121.

would have been used mainly for grinding nuts, and querns and handstones for seeds (Henry, 1989; Olszewski, 1993). Heavier equipment was probably cached at convenient locations where gathering camps would be established each year.

The nature of gazelle exploitation by Natufians has been much debated. Gazelle is certainly the main animal represented in many late Pleistocene and Holocene faunal samples in Palestine. When Legge (1972) calculated the ages at which the gazelle were being killed at Nahal Oren in Israel, using the evidence of unfused and fused metapodials (the distal articular ends or epiphyses fuse onto the shafts when the animal is about 2 years old), he found that over half of the gazelle in the Kebaran, Natufian, and earliest Neolithic ('Pre-Pottery Neolithic A', or 'PPNA') levels were immature (Table 4.3). Many other sites had similar evidence. Commonly there was then a sudden switch to sheep and goats dominating faunal samples in the succeeding Pre-Pottery Neolithic B period, with many immature animals again being represented. If PPNB people were herding sheep and goats, he concluded, the logical conclusion had to be that Natufian and PPNA people were herding gazelle (Legge, 1972, 1977).

However, male and female gazelle were represented equally in the Natufian faunal sample from Hayonim Terrace analysed by S. Davis (1983), whereas herders would normally be expected to keep more females for breeding and to cull surplus males. Also, both gazelle and fallow deer were represented at Hayonim as complete carcasses, suggesting that they were being exploited in the same way, that is, hunted. Legge and Rowley-Conwy (1987, 2000) came to the same conclusion from analysing the Abu Hureyra fauna, that gazelle were being hunted not herded. They argued that Natufians developed highly organized systems of hunting gazelle on the steppes, trapping large numbers in stone enclosures or 'kites' when they migrated northwards into the vicinity of the site (Helms and Betts, 1987; Fig. 4.8). Campana and Crabtree (1990) developed the argument further from their analysis of fauna from Salabiya I in the lower Jordan valley, where the herd structure indicated the kind of catastrophic mortality produced by a mass kill. There are no stone kites in the

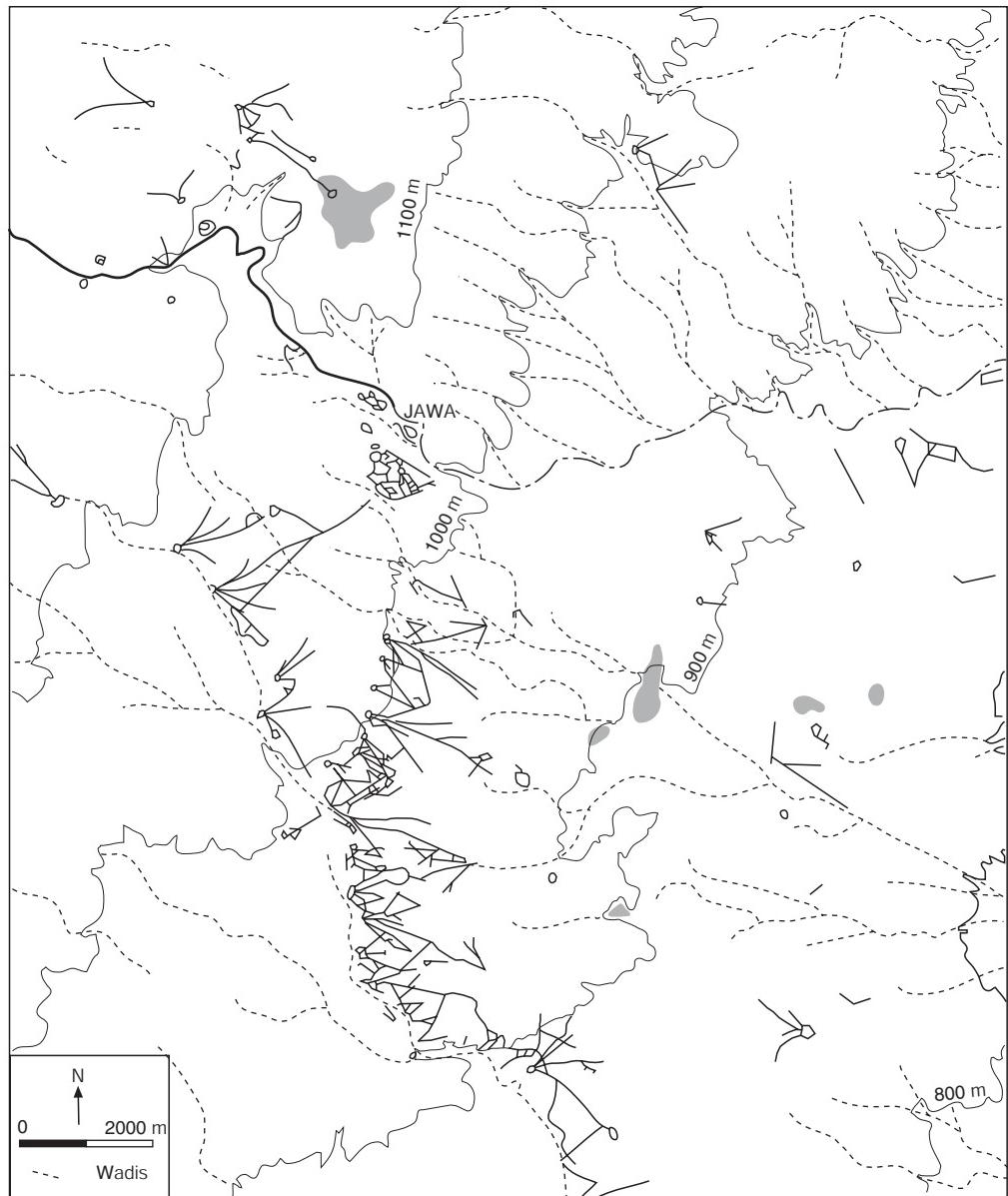


Fig. 4.8. Stone 'kites' on the Jordanian steppes near Jawa, thought to be traps for the mass killing of gazelle; grey denotes major water catchment zones (after Helms and Betts, 1987: fig. 3)

Jordan valley, so they concluded that Natufians were organizing communal game drives, using fire to stampede the herds into netted enclosures. The evidence for the use of nets, they suggested, is the wide range of small game also represented in the faunal samples such as hares and foxes, which would have been caught up in the nets (though the numbers of raptor species of birds, along with the presence of their prey species such as small game, could be taken as in the case of Ohalo as evidence for the practice of falconry: Dobney, 2002). Presumably dogs were also used by Natufian hunters: domestic dogs have been found at El Wad, Hayonim Terrace, and 'Ain Mallaha, the latter site having a burial of a man lying with a dog or wolf puppy, his hand resting on the animal's chest (Davis and Valla, 1978). Butchery studies show that the gazelle carcasses were intensively processed for bone marrow and grease as well as meat (N. Munro, *pers. comm.*).

Studies of Natufian teeth suggest a diet rich in carbohydrates, and analyses of strontium/calcium ratios in skeletons also indicate that Natufians ate more plant food than either Kebarans before them or contemporary people living in the Zagros mountains (Schoeninger, 1981, 1982; Sillen, 1984; P. Smith *et al.*, 1984). In contrast, Olszewski (1993) presented the 'minimalist' case for the consumption of cereals by Natufians, arguing that the chemical studies can be discarded on the grounds that they did not take into account the possible biasing effects of the chemistry of the soils in which the bodies were buried, the direct botanical evidence is limited, sickles are relatively few, and many need not have been used for cereals. Rather, she argued, the main staples in the coastal and forest regions were acorns and gazelle.

However, whilst gazelle were certainly the critical meat source and acorns no doubt an important vegetable staple, the evidence that cereals were critical to Natufian diet remains strong. Chemical work that has taken account of soil chemistry has continued to find strong evidence of plant foods in the diet (Liebermann and Bar-Yosef, 1994; Sillen and Lee-Thorpe, 1991). The archaeobotanical evidence from sites such as Abu Hureyra and Mureybit shows the importance of cereals even in what were probably fringe areas of their distribution. Microwear studies of the edge damage on several hundred Natufian sickle blades, compared with the edge damage on replica blades used for cutting a variety of wild and domestic cereals and other plants, demonstrate their regular and systematic use for cereal harvesting (Unger-Hamilton, 1989). Many Natufian sickles have the gloss that comes from cutting through cereal stems, and Unger-Hamilton's experimental work showed that about 10,000 strokes were needed to produce this gloss. She also found that many Natufian sickles had an 'inflated' polish which she showed came from harvesting plants when they were unripe or green. Presumably Natufians could not wait till the plants were fully ripened, because if they did, the heads would

shatter when struck by the sickle. (We know from the botanical remains of sites such as Abu Hureyra and Mureybit that the cereals had brittle rachises, rather than the tough rachises of modern domesticated cereals.)

Unger-Hamilton also noted striations on many sickles that she decided were caused by loose soil attached to plants near the ground, evidence that Natufians were practising tillage. However, although Moore (1982) concluded from the discoveries at Mureybit and Abu Hureyra that Natufians must have been 'cultivating wild cereals' (a famously quoted phrase), the consensus now is that they were collecting wild cereals intensively, but probably not cultivating them. If Natufians had been cultivating cereals systematically, morphological changes would have taken place rather rapidly (Hillman and Davies, 1990). On the other hand, given the sickle evidence for tillage, it seems likely that Natufians were beginning to intervene to enhance cereal growth, along the lines of the plant-tending strategies of many modern foragers described in Chapter 2, for example by the removal of competitor plants from existing stands and planting seeds to make new ones (Sherratt, 1997). They may also have been using fire to enhance grazing conditions for gazelle (Hillman, 1996). It is certainly assumed that they were storing plant foods in the storage facilities that are common in their settlements. Presumably they would also have had to dry and store much of the gazelle meat that would have come from a successful communal hunt. Whether or not they were cultivators in a modern sense, therefore, Early Natufians were certainly 'delayed return' collectors who were actively manipulating the plants and animals on which they depended. In particular locations these forms of subsistence clearly sustained more or less permanent settlements.

Furthermore, many of the settlements have burials, and there are indications of varied treatment of the dead. In the Early Natufian in particular, adults, children, and infants were normally buried together, especially under the floors of structures, though others were buried nearby (Fig. 4.6). Some were extended, others flexed (with the knees drawn up towards the chin). The composition and locations of the burials suggest that the family or household was now the residential unit, as in traditional agricultural societies. The role of the household dwelling as the locus of Natufian food storage, preparation, and consumption contrasts strikingly with the communal hearths and pits outside the dwellings at Ohalo II. Furthermore, there are indicators of status differences within burial clusters, suggesting that families were members of sub-groups such as clans. Some people were buried with little or no ornamentation, others had a variety of necklaces, garters, and bracelets made of dentalium shell, canine teeth, deer phalanges, and so on. Two individuals at El Wad and 'Ain Mallaha had particularly elaborate dentalium headdresses (Garrod and Bate, 1937; Perrot, 1966).

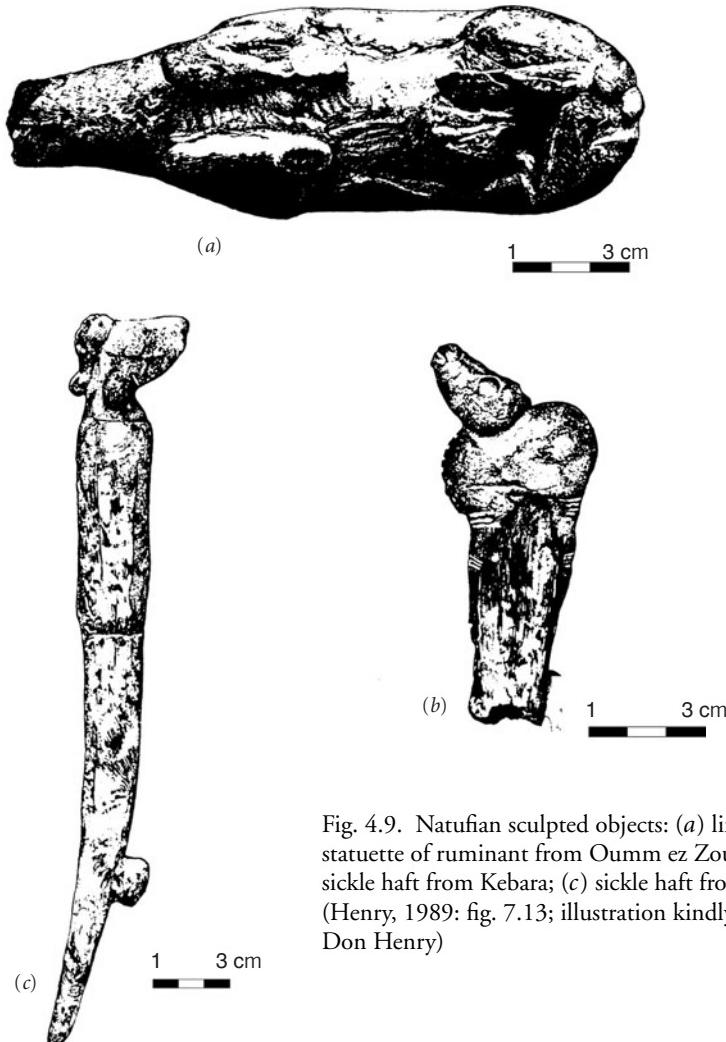


Fig. 4.9. Natufian sculpted objects: (a) limestone statuette of ruminant from Oumm ez Zoueitina; (b) sickle haft from Kebara; (c) sickle haft from El Wad (Henry, 1989: fig. 7.13; illustration kindly provided by Don Henry)

Time and effort were expended on decorating bone-work. Many utilitarian objects were decorated as well as items of personal grooming and ornament, the most decorated being placed in the burials. Some of the most striking are representations of deer (Fig. 4.9). The most elaborate, and locally specific, artwork is invariably on artefacts which women may have used, such as ostrich-eggshell bottles, stone bowls, and hide-working tools, whereas male objects tend to display regional styles. Henry (1989) postulated on this evidence that Early Natufian society was matrilocal, that is, with women remaining in a community through their life rather than marrying out. He argued that Early Natufian communities divided into two or three clans or family groups, the

latter being the principal arenas of decision-making. The thesis of communal hunting might argue against this, though: Campana and Crabtree (1990) used ethnographic examples to argue that game drives need little organization but that net hunting does, citing the example of the Mbuti pygmies who have to get a score or more of families together to undertake a net hunt. Rowley-Conwy (1991a), however, pointed out that the Mbuti are very suspicious of any attempts by individuals or individual families to impose their authority on the group's decision-making. However that may be, the cumulative evidence for Early Natufian social structure indicates that in this respect they may have had more in common with later agricultural societies than with Kebaran foragers.

Late Natufian Culture

Through the course of the Early Natufian, the climate gradually became colder and drier, accelerating at about 11,000 BC as the Younger Dryas cold stage developed (Fig. 4.5). The rising populations of the Early Natufian were now confronted by suddenly declining returns from foraging. For example, the sharp change in climate affected the ability of the wild cereals to photosynthesize, and diminished their productivity. People responded to the crisis in different ways: some moved; some diversified their subsistence system; and some intensified it, though overall there are indications of poorer diet and declining health (P. Smith, 1991).

In the middle Euphrates valley, Abu Hureyra was abandoned as the park woodland and cereals retreated from its environs (Hillman, 1996). Similar foci of settlement in the steppe region such as Azraq and El Kowm were also abandoned. In the Negev and Sinai, people responded to increasing aridity by broadening their subsistence base. Sites such as Rosh Zin and Rosh Horeشا, with dwellings and storage pits, are interpreted as the summer aggregation camps of foraging groups surviving in the Negev at this time by plant collection and broad-spectrum hunting (Bar-Yosef and Belfer-Cohen, 1992). Pressure would have been worst, though, in the primary zone of Natufian settlement, the Levantine corridor. One response here was to focus ever more intensively on gazelle hunting: greater numbers of juveniles reflect hunting pressure on the gazelle herds, and greater numbers of males may indicate deliberate attempts to conserve the herds better (Cope, 1991). Increasing frequencies of microliths are often taken to indicate an increase in hunting, but the skeletal studies generally show increasing quantities of plant food in the diet, so it seems likely that people in the Levantine corridor were trying to ameliorate their plight by hunting an ever wider range of game, and further

afield, though in fact for fewer returns (Henry, 1989). It is interesting that at Beidha the faunal sample has fewer goats, the natural habitat of which was the relatively lush cliffs and slopes around the site, and more ibex, an animal that had to be hunted further away in the arid gorges of the Wadi Araba rift valley (Uerpmann, 1987). Mainly, though, Natufians here began to concentrate even more on collecting cereals even though they were hard work to process, relatively unpalatable to eat with the technology available (making some kind of gruel or porridge), and declining in their distributions (McCorriston and Hole 1991; Moore and Hillman, 1992).

Places that had been ideal for mixed hunting, fishing, and gathering were less suitable for cereal stands and dependable water supplies. Better locations for cereals in the new climatic regime were the lowland alluvial soils of the kind being exposed by the shrinking lakes of the Jordan valley, at places like Jericho. However, increasing intervention would have been necessary to promote cereal growth in such places, which had not been primary cereal habitats. On these alluvial soils, preparing ground, transplanting seeds, weeding out competitor plants and so on would have been necessary to sustain cereal yields in the face of Younger Dryas aridity and cold (Sherratt, 1997). Such activities perforce drew people into the gamut of activities we define as horticulture, in time including deliberate seed selection. Also, the greater commitment to nurturing cereals in particular locations meant less mobility, and fewer opportunities for hunting, further propelling people into a greater dependency on plants.

Late Natufian burials consist generally of single interments in cemeteries, rather than household clusters. Detached human skulls at sites such as 'Ain Mallaha, Shukbah, and Nahal Oren suggest that the skull cults found later at Neolithic Jericho (skulls with human features modelled onto them in clay) had their origins in Natufian funerary ideologies (Goring-Morris, 2000). There were also increasing networks of exchange, over longer distances, the increasing circulation of what seem to have been status symbols (such as shells from the Mediterranean, the Sea of Galilee, and the Red Sea) indicating an increasing concern with rank and prestige. Together, the changes in burial and exchange suggest the development amongst Late Natufian societies of new community-wide, rather than kin-based, positions of status and systems of decision-making (Henry, 1989). An important focus of such community-wide authority at alluvial settlements such as Jericho would presumably have been the control of critical resources such as stands of oak trees and of cereals, particularly as community investment in tending the latter increased. Matrilocality and endogamy would have been further reinforced by these developments. Whether gender roles shifted with increasingly interventionist plant exploitation is an open question. One scenario is that women undertook

most of the cereal work, another is that men were increasingly involved in activities such as ground preparation and transplanting.

FORAGING IN THE ZAGROS MOUNTAINS, c.13,000–9500 BC

The Zagros mountains are an extensive region with a complex topography, with different vegetations adapted to altitude, latitude, temperature, precipitation, and exposure. Models of how the landscape changed through the Bølling–Allerød interstadial and the Younger Dryas stadial remain rather general, based on a very few pollen diagrams. The archaeology of the region contemporary with the Natufian is also poorly understood, based largely on the surveys and excavations of the 1950s and 1960s. These indicate few sites outside caves and rock-shelters. The faunal samples show that people were broad-spectrum hunters of gazelle, onagers, goat, sheep, red deer, cattle, pig, and so on (Braidwood and Howe, 1960; Hole and Flannery, 1967). There are no plant remains. The pollen diagrams indicate that the landscape remained very open during the Bølling–Allerød interstadial, and the assumption is that with wild cereals far less abundant than further west, people remained mobile, living by hunting, fishing, and gathering, the latter particularly focused on tree fruits (Hillman, 1996; Hole, 1996).

The Younger Dryas forced trees back into the refugia they had occupied in the Late Glacial. Surveys of the northern steppes around the headwaters of the Euphrates and Tigris valleys indicate regions devoid of significant settlement at this time, and the higher mountain valleys of the Zagros also seem to have been abandoned (Hole, 1996: 270). In the main zone where settlement concentrated, the foothills of the Zagros, there are signs of greater investment at living sites in sheltered locations. Small-scale structures were constructed within caves and on platforms outside them, stone foundations for simple round or oval shelters. The fauna at these sites consist predominantly of sheep and goats, both morphologically wild. Perkins (1964, 1973) argued that the sheep at Zawi Chemi Shanidar were being herded, because the site had more sheep, and more immature sheep, than at Zarzian Shanidar near by, but his theory has found little support: as with gazelle, the same mortalities could have been produced by communal game drives (Crabtree, 1993). Hole (1996: 271) suggests that the house structures and grinding equipment together indicate sedentism and intensive plant gathering: ‘the more severe conditions of the Younger Dryas may have stimulated intensive utilization of these foods and perhaps given impetus to new techniques for managing or husbanding food resources’. Unfortunately the paucity of the evidence compared with that of the Levant means that such an interpretation, however plausible, remains

speculative. At least it can be said with reasonable confidence that one response to Younger Dryas aridification in the Zagros was to concentrate on killing sheep and goats, species which would have been increasingly restricted to the Zagros foothills at this time. As noted earlier, communal drives have similar implications for food storage as intensive plant gathering and processing.

PRE-POTTERY NEOLITHIC A FORAGERS AND FORAGER-FARMERS, c.9500–8500 BC

The cold and arid conditions of the Younger Dryas lasted for about 1,500 years, until the middle of the tenth millennium BC, when there was an extraordinarily sudden rise in global temperatures once more (Fig. 4.5). This sudden warming, calculated as a seven-degree rise in mean July temperatures within a couple of generations, marked the transition to the Holocene. Temperatures then climbed consistently over the next 2,000 years (Lowe *et al.*, 1995). The dramatic transition from the Younger Dryas to the Holocene coincides with the emergence of Neolithic culture throughout South-West Asia. Although pottery was traditionally regarded as a defining attribute of Neolithic culture, early excavations such as those by Kathleen Kenyon at Tell el-Sultan (Jericho) established that the first farming communities of South-West Asia did not make pottery, though they understood the properties of baked clay, for example for bricks and figurines. Levantine archaeologists divide these 'Aceramic Neolithic' communities into earlier and later phases, termed Pre-Pottery Neolithic A and B, or PPNA and PPNB. Though the terminology is not used consistently in the Zagros, there is similar evidence for an initial phase of transitional societies, perhaps lasting a millennium, followed by the widespread appearance of communities practising integrated systems of mixed farming, so I shall use PPNA and PPNB for the region as a whole.

PPNA sites vary considerably in size. There are very small surface scatters (*c.*100–150 m²), medium-sized sites *c.*2,000–3,000 m² in extent, and a few larger ones of 2–3 hectares, the latter with architectural remains. Given that most Natufian sites measure *c.*1,000–2,000 m², this evidence suggests significantly more people now, especially in the Levantine corridor, where populations of a few thousands have been estimated for the largest sites (Kuijt and Goring-Morris, 2002). Jericho remains unique in that the settlement was enclosed by a substantial wall at this time that 'in conception and construction ... would not disgrace one of the more grandiose medieval castles' (Kenyon, 1957: 68; see also 1959, 1960), though it is unclear whether this was built to defend the site against people, or flooding, or both (Bar-Yosef and Belfer-Cohen, 1992). Most other PPNA settlements in the Levant, sites such as Netiv

Hagdud (Bar-Yosef and Gopher, 1997), Wadi Faynan 16 (Mithen *et al.*, 2000), Dhra' (Kuijt and Finlayson, 2001; Finlayson *et al.*, 2003), Iraq ed-Dubb (Kuijt *et al.*, 1991), and Tell Aswad (de Contenson, 1995), have much more modest architecture. Netiv Hagdud is typical, with oval semi-subterranean structures in form much like Natufian structures, 4–6 metres long and without internal divisions, but more substantially constructed, made of various combinations of stones, mud, and crude loaf-shaped bricks baked in the sun (Fig. 4.10). Such structures are assumed to have been conical huts, though other dwellings may have had flat roofs. Plastered floors and internal hearths suggest that most structures are dwellings. In the foothills of the Zagros, too, settlements at this time such as Nemrik and Qermez Dereh consisted of clusters of oval, semi-subterranean dwellings, the superstructures being supported by plaster and stone pillars (Kozlowski and Kempisty, 1990; Watkins, 1990, *et al.*, 1989). Most settlements have clusters of such dwellings. Unusually, Nahal Oren has four rows of houses, but the layout has more to do with coping with the steep topography by placing houses on terraces than a planned system. Another unusual building was found in recent excavations at Dhra': a semi-circular mud-walled structure with curious pillars in its interior, which might have a functional purpose but might conceivably indicate a special building set aside for religious activities of some kind (Finlayson *et al.*, 2003). Although there have been few studies of seasons of occupation, the assumption is that many of the major settlements were now permanent. Wadi Faynan 16 was certainly occupied in the summer and the winter; whether such seasonal visits were successive or part of continuous occupation is not clear, though the amount of evidence for intensive manufacturing activity including the working of reeds, wood, hide, and stone, along with numerous heavy mortars and grinding slabs, leads the excavators to favour year-round occupation (Mithen *et al.*, 2000).

Burial systems remained much as in the Later Natufian, most consisting of single interments without grave-goods, but there are also examples of under-floor burials. Particularly intriguing are instances of skulls being removed from adult bodies a few years after death, the lower jaws remaining with the rest of the body. At Netiv Hagdud there was a cluster of crushed skulls on the floor of a house, together with grinding slabs, pounding tools, and cup-holes (Bar-Yosef and Belfer-Cohen, 1992: 36). Gilgal, a site excavated extensively, has no burials, but it is thought to have been a seasonal foraging site (Bar-Yosef and Meadow, 1995: 63). Probably burials were used in part to signify a community's sense of belonging to its particular landscape.

PPNA lithic technology was similar to Natufian in the use of microlithic tools, presumably mainly hunting equipment, but there were many more heavy-duty tools such as picks, adzes, and planes, more blade tools (including

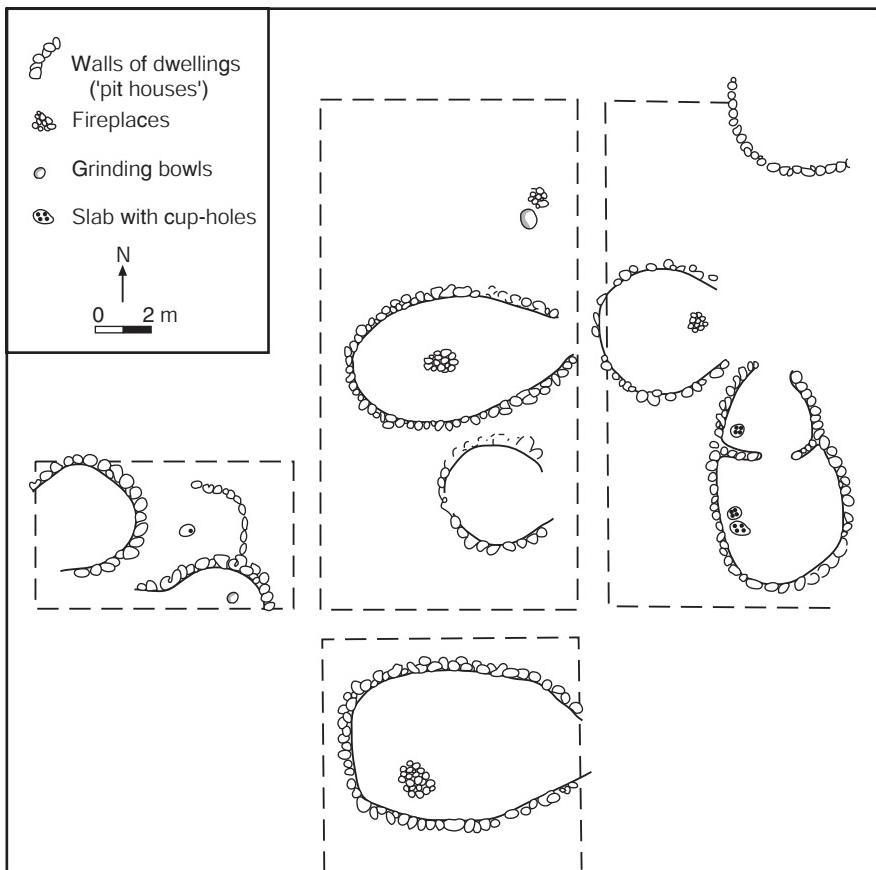
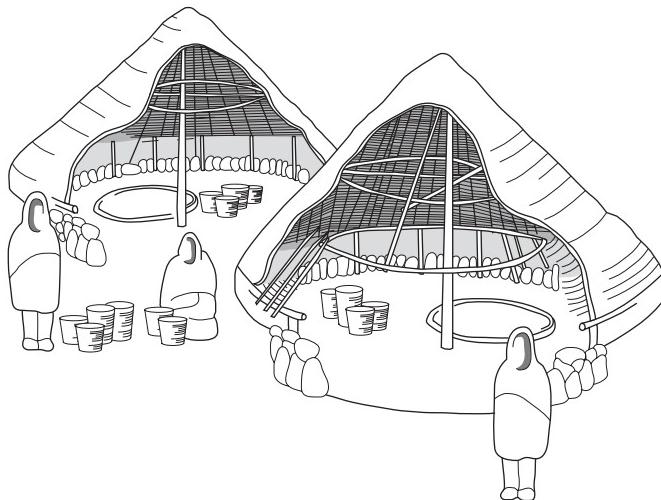


Fig. 4.10. PPNA
Netiv Hagdud:
(above) plan of
structures; (right)
a reconstruction of
one of the PPNA
huts (plan after
Bar-Yosef and
Belfer-Cohen,
1992: fig. 7;
reconstruction after
Kuijt and
Goring-Morris,
2002: fig. 3)



many sickles), and a wide variety of grinding equipment (Fig. 4.4). Querns and hand-stones gradually replaced mortars and pestles, as people came to rely more and more on cereals (Byrd, 1989). Cooking was done by households, the main method involving heated stones on the cobbled floors of hearths. A variety of cordage from basketry and nets has also survived.

Experimental work by Hillman and Davies (1990) suggests that, under regimes of annual sowing and sickle harvesting, wild einkorn could have acquired the morphological characteristics of domesticated einkorn within a remarkably short period: they arrived at minimum and maximum figures of 20 and 200 years. However, if some people harvested wild cereals simply by knocking the heads into baskets (a practice widely attested ethnographically), and also if early tillage practices allowed intermixing between husbanded plants and wild plants (for example, early cultivators might have weeded only the more accessible parts of cereal stands, or transported seeds from natural stands to crudely prepared patches of soil near by), the process of change could have been far more protracted. One of the problems with the interpretation of PPNA subsistence behaviour, therefore, is that whether a plant is morphologically wild or domestic almost certainly cannot be taken as a simple guide to whether it was husbanded in some way or just harvested (Harris, 1998). The indications are that most PPNA people lived by harvesting wild cereals, gathering nuts and fruits, hunting gazelle and other ungulates, fishing, and trapping small mammals and birds. Some of them, however, in addition to such foraging, were also beginning to cultivate cereals and pulses on patches of alluvial soil beside their settlements.

In the Levantine corridor there is the first generally accepted evidence that the main settlements were being sustained at least in part by the cultivation of plants, though wild seeds and fruits continued to be staple foods as well (Bar-Yosef and Kislev, 1989; Byrd, 1992). The first morphologically domestic cereals now occur: emmer and hulled two-row barley at Jericho; and emmer, peas, and lentils at Tell Aswad (de Contenson *et al.*, 1979; Hopf, 1983; van Zeist and Bakker-Heeres, 1982). Both are sites in lowland situations close to damp alluvial soils, the prime location for many later Neolithic villages in the region (Sherratt, 1980); seeds of marsh species were in fact mixed in with the Aswad crops. Most plants at Tell Aswad are morphologically wild (barley, almonds, legumes, figs, pistachios), and barley at Netiv Hagdud has a few examples with the tough rachis but more examples of brittle ones (Kislev, 1997; *et al.*, 1986). Kislev (1989) argued that most cereals and legumes were still probably not being cultivated intentionally, but the size of the big PPNA settlements in the Levantine corridor, though they are few in number, indicates significant changes in the subsistence systems by which they were being maintained, rather than simply the continuation of what people had been doing in the

Late Natufian but in a more favourable environment. Bar-Yosef and Belfer-Cohen (1992) suggest that sedentism and cereals, an excellent food for weaning newborn babies, were the explosive cocktail that in combination enabled populations at these locations to increase rapidly.

Whether herding was also a significant factor in sustaining these settlements remains unclear. The principal animal eaten at most PPNA sites was still gazelle, the rising number of juveniles suggesting ever more intensive systems of culling. Wadi Faynan 16 is unusual in having a predominance of goats, though this may be explained by the craggy terrain adjacent to it (the site is at the junction of the Wadi Arabah and the Jordanian plateau). The increasing variety in PPNA faunas of smaller animals such as fox and hare, and waterfowl, along with the larger game such as cattle, fallow deer, red deer, roe deer, and pig, might be an indication of hunting stress. The weight of the evidence suggests that Levantine PPNA people were hunters rather than herders, though the small size of the goats at Wadi Faynan 16 and the equal numbers of mature and immature animals may be evidence for a domesticated herd (Mithen *et al.*, 2000).

PPNA settlement was as complex and variable beyond the Levantine corridor. In the more arid regions, such as the Negev and Sinai, people seem to have continued to live as small-scale foragers, whereas a mix of foraging and farming was sometimes practised in better-watered country though there is also evidence for significant communities being sustained by foraging alone. In the cave of Iraq ed-Dubb in the Jordanian highlands, for example, one of a series of oval stone structures 4–5 m in diameter outside the cave contained grains and chaff of domestic barley and spikelet forks and glume bases of a domestic glume wheat (probably emmer rather than einkorn), wild or domestic lentil, a legume of the genus *Vicia* (possible faba bean) and other legumes, as well as field weeds such as *Lolium* and *Phalaris* (Colledge, 1994; Kuijt *et al.*, 1991). The einkorn and barley at Mureybit on the Syrian steppe are morphologically wild, as are the lentils, peas, vetches, and flax there. It used to be thought that the cereals must have been transplanted to the site because the uplands that are their natural home are 100–50 kilometres away to the north-west, but it now seems likely that the rapid warming and increasing rainfall of the start of the Holocene allowed wild cereals to expand rapidly over the steppes to the vicinity of the site. Whether the people at Mureybit were cultivators remains much debated. First it was thought so, then not, but multivariate analyses of the wild/weed taxa indicate that the einkorn was growing on the Euphrates alluvium with the benefit of deliberate tillage (Colledge, 1998). The Turkish site of Çayönü Tepesi, on the other hand, has produced seeds of domesticated einkorn, interestingly in the same zone that Heun *et al.* (1997) identified as the focus of einkorn domestication on the basis of genetic patterning in modern

einkorn. A detailed study of pig remains from the site, including age-at-death estimations, metrical analysis, and the recording of a dental defect (Linear Enamel Hypoplasia, an indicator of physiological stress), suggested a population living in some kind of intermediary relationship with humans between wild and domestic, perhaps with piglets being taken from local wild populations, or from sub-populations living closer to human settlements (Ervynck *et al.*, 2001), rather like the semi-wild/semi-domestic reindeer populations of the Sámi (Chapter 2, pp. 68–9).

Jerf el Ahmar, a PPNA site excavated before the construction of Lake Assad, appears to have been on a par with the complex and substantial settlements of the Levantine corridor. It had what seems to have been a centralized grain silo and a (presumably) ritual building with bulls' skulls attached to it, associated with stone plaquettes with pictograms that appear to represent some kind of symbolic code (Stordeur *et al.*, 1996, 1997). Even more remarkable is the site of Göbekli Tepe in south-eastern Turkey, apparently a ritual centre where PPNA foragers (there is no evidence for domesticated crops or animals) carved massive T-shaped pillars out of the limestone bedrock and decorated them with carvings of aurochs, birds, foxes, gazelle, snakes, and wild boar (Schmidt, 2001). The pillars (from quarries near by) imply the mobilization of significant labour for their construction, transport, and erection, suggesting that numerous communities had to come together and cooperate in the site's creation and that it may have served as a ritual focus at a more than local scale.

In the Zagros region of Iraq and Iran, though the evidence is generally dated, the picture appears to consist of greater and lesser degrees of sedentism but in either case sustained by foraging. The onset of Holocene conditions enabled people to expand out of the piedmont or foothills both onto the northern steppes and to higher elevations in the mountains, but there is little or no evidence of cultivation or herding. The chemistry of skeletons from Ganj Dareh, an upland site, indicates a diet dominated by meat rather than plant food (Schoeninger, 1981). On the steppes, the inhabitants of Qermez Dereh and M'lefaat lived by hunting (especially gazelle and smaller taxa such as fox and hare, but also cattle, goat, onager, and sheep), gathering seeds and fruits (wild einkorn, wild barley, legumes, almonds, pistachios, plums), and also collecting clams (Dobney *et al.*, 1999; Rosenberg *et al.*, 1995; Watkins, 1990). Domesticated barley has been reported from Ganj Dareh (van Zeist *et al.*, 1986), though it may be later. Bökönyi (1976) argued that the goats at Asiab, in the same zone, were also domestic, on the grounds that most of the sample consisted of male mature animals, and that there were examples of horn cores beginning to show the signs of flattening of the domestic goat's horn. On this evidence he postulated that people here were practising

'proto-herding', taking adult animals in order to try to capture their young to tame them, rather as may have been the case with the pigs of Çayönü Tepesi. The analysis of the large faunal sample (*c.*50,000 fragments) from Ganj Dareh revealed that the goats were mainly adult females and males under a year old, indicative of selective hunting of 'nursery' herds of females and young, rather than herding (Hesse, 1984), but recent re-analysis suggests instead herd management, though of morphologically unchanged animals (Zeder, 2005). The Asiab material was also probably the result of the selective hunting of male goat bands. The similarities in the mortality evidence suggest that goat hunting rather than herding is also more likely in the earliest (Bus Mordeh) phase at Ali Kosh. As the lowland settlements are more substantial than the upland sites, Hole (1996: 271) suggested that, whilst the main communities may have been permanent on the lowlands, many upland sites may be seasonal camps. The hunters of the Zagros who were following the herds of sheep and goats in their seasonal movements between lowlands and uplands were establishing a pattern of close observation, selective exploitation, and a rhythm of seasonal movement, that can at least be regarded as the prerequisite of herding.

PRE-POTTERY NEOLITHIC B FARMING COMMUNITIES, *c.*8500–6500 BC

About a thousand years into the Holocene there was a veritable explosion in agricultural settlement throughout South-West Asia and beyond to the west and east. Communities based on mixed farming can now be identified from Cyprus (Chapter 9, p. 335), south-central Anatolia, and the Levant eastwards across the Zagros and possibly onto the Iranian plateau as well (Chapter 5). Most PPNB sites are 2–12 hectares in size, the larger sites usually being 'tells', mounds of debris composed especially of collapsed dwellings made of mud and mud brick (Bar-Yosef and Meadow, 1995; Rollefson, 1989). The best-known larger settlements, with populations of perhaps 1,000–2,000 people, include: Tell es-Sultan at Jericho (Kenyon, 1960, 1981; Kenyon and Holland, 1983), Beidha (Byrd, 1994; Kirkbride, 1966), and 'Ain Ghazal (A. H. Simmons *et al.*, 1988) in the southern Levant; El Kowm (Dornemann, 1986), Bouqras (Akkermans *et al.*, 1983; van Zeist and Waterbolk-van Rooijen, 1985), and the reoccupied Tell Abu Hureyra (Moore, 1975, 1979; Moore *et al.*, 2000) in the northern Levant; Çayönü Tepesi (Braidwood and Braidwood, 1982; Özdogan and Özdogan, 1989), Haçilar (Mellaart, 1970), and Çatalhöyük (Hodder, 1987, 1996, 2000; Mellaart, 1967) in Anatolia (Turkey); and Maghzaliyah (Bader, 1993) and Nemrik (Koslowski and Kempisty, 1990) in Iraq. The principal new characteristic in the composition of these settlements was the construction of



Fig. 4.11. Abu Hureyra: the contrast between the circular shelters used by Natufians (below) and (above) the substantial rectangular houses built by PPNB farmers (Moore *et al.*, 2000: fig. 5.4; photograph kindly provided by Andrew Moore; scale 1 m)

substantial square or rectangular dwellings, often with stone foundations and walls made either of *tauf* or *pisé* (mud on a withy frame, baked in the sun) or mud-brick (Figs. 4.11, 4.12). At Basta in Jordan, a settlement constructed of stone, the walls survive to their full height (Nissen *et al.*, 1987). The floors were often plastered with a mortar made by mixing burnt and pounded limestone with water, especially of buildings that seem likely to have been of higher status (Garfinkel, 1987). Storage pits, silos, and hearths are common, invariably within the house (K. I. Wright, 2000). It seems certain that the household was now the primary unit of production and consumption.

The lithic technology demonstrates increasing efficiency through the use of bipolar-flaked cores and pressure flaking, to produce standardized blades that were then fashioned into equipment for hunting (geometric microliths, tanged arrowheads), harvesting (sickle blades), heavy wood-working (axes), finer carpentry, leather-working, and other craft production (burins, scrapers, borers, and so on). Querns and hand-stones were produced in large quantities. A number of sites have also produced fragments of cordage and basketry; there were fragments of bitumen with basketry impressions at Abu Hureyra, for example (Hillman *et al.*, 1989a), and the Nahal Hamar cave south-west of the Dead Sea contained desiccated remains of mats, baskets, vessels, nets, and quivers, as well as fragments of linen (Schick, 1988). Through the course of the PPNB, some communities such as at Abu Hureyra also started to manufacture large vessels of gypsum and lime plaster (termed 'White Ware'), probably for storing foodstuffs (Moore, 1995).

The principal PPNB settlements are invariably situated in low-lying locations by a good water supply and near moisture-retentive alluvial soils (Sherratt, 1980). Marsh seeds mixed into crop residues at several sites indicate that these soils were especially selected by PPNB farmers for growing cereals (van Zeist, 1988). Though people certainly collected fruits and nuts, hunted, and ate the meat of their herds, the skeletal studies indicate that their diet was heavily dominated by roughly ground cereals (Molleson, 2000; Molleson and Jones, 1991). Sickles, often heavier-duty compared with Natufian and PPNA examples, were used to harvest ripe or dry cereals, which was now possible because of their tough rachises (Unger-Hamilton, 1989). The botanical record demonstrates the rapid appearance of a wide range of morphologically domestic crops. There is widespread evidence that PPNB farmers were not just cultivating the so-called 'founder crops' (einkorn, emmer, two-row barley) but also naked six-row barley, free-threshing bread and hard wheats, a variety of pulses (lentil, vetch, pea, chickpea), and flax (Miller, 1992).

The first widespread evidence for herding sheep and goats is found in the Zagros and Taurus regions at the beginning of the PPNB (Uerpmann, 1987, 1996). Evidence for goat herding in the mortality structures at Ganj Dareh coincides with morphological changes (flattened horn cores) and caprine footprints preserved in mud brick, indicating that tamed goats were being kept on site (Hesse, 1984; Zeder, 2005). There are similar flock structures at Ali Kosh in the second (Ali Kosh) phase of the settlement (Flannery, 1969). Sheep and goats were also killed as young adults at Çayönü Tepesi, and Lawrence (1982) suggests that the sheep at least may have been herded on the grounds that their numbers increased and size decreased at this time. The use of tamed sheep and goats then seems to have developed extremely rapidly, with reliable evidence at sites such as Çatalhöyük (where worn shed deciduous teeth

indicate the penning of sheep within the settlement: Russell and Martin, 2005), Jericho (Clutton-Brock, 1979), 'Ain Ghazal (Kohler-Rollefson, 1989), and Beidha (Kirkbride, 1966).

The indications are, therefore, that the earlier part of the PPNB was characterized by the 'fitting together' of the various components of the cereal, legume, sheep, and goat mix. From our own perspective, we can understand how they complemented each other. Both sheep and goats needed a wider range of food than gazelle (sheep need grazing, goats prefer browse), and more water. The locations of the PPNB settlements were poorly suited to the needs of gazelle and better placed for those of sheep and goats in terms of food (both natural and cultivated) and water. The fact that sheep, goats, cereals, and legumes often appear together in the Levant suggests that what were now increasingly sedentary communities were realizing the benefits of husbanding these resources together. Putting sheep and goats onto cereal stubble after the harvest was good for the animals (food) and good for the ground (manure), and once people started using straw for livestock bedding and feed, they would have been producing rotted manure to put back on the fields. Neolithic mixed farming may also have involved the systematic use of burning of rangeland beyond the arable fields to regulate vegetation structure and composition to improve livestock grazing (N. Roberts, 2002). The people who returned to Abu Hureyra after its abandonment in the Younger Dryas practised this kind of mixed farming: growing emmer, einkorn, barley, and legumes, herding sheep and goats, and dumping mixtures of weed seeds that we would expect to find in cereal and fallow fields (Hillman, 2000; Hillman *et al.*, 1989a). High frequencies of pathologies especially in the foot bones (phalanges) of the goats at 'Ain Ghazal may be an indicator of stalling them in unsuitable conditions (Crabtree, 1993). The evidence that sheep and goats consistently decreased in size through the period (Helmer, 1992; Uerpmann, 1979) may also in part reflect the effects of early systems of flock management.

Of course farming communities still made use of wild animal and plant foods. Game may have been hunted from the main settlements, as much to protect the cereal fields as for meat, as well as as a social activity. Presumably hunting parties also ranged further afield: Umm Dabaghiyah on the desert steppe in Iraq, for example, seems to have been a base for seasonal hunting of animals such as onager and gazelle, used by people who must have come from a farming village who came with rations including domestic cereals but who were not cultivating such crops around the settlement (Kirkbride, 1982).

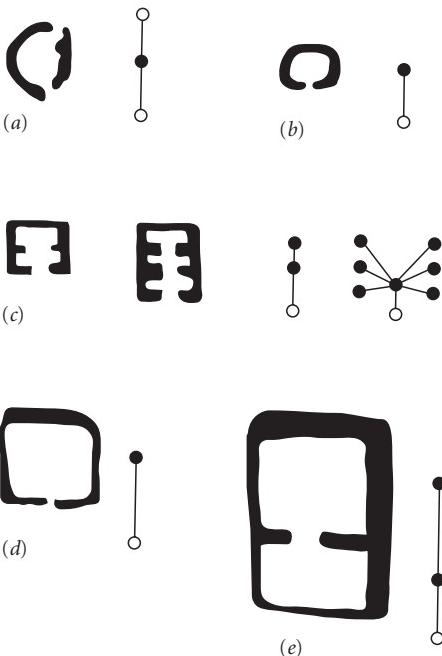
In the drier steppe and desert areas, hunting and gathering continued as the primary means of subsistence. Surveys and excavations in and around the Azraq basin have revealed a series of semi-permanent seasonal camps with curvilinear domestic structures, hunting camps, and stone kites, indicating that the steppes were still used for communal gazelle hunting as in

earlier times (Betts, 1988; Garrard *et al.*, 1988). There is also evidence for foragers in the Negev and Sinai (Bar-Yosef, 1984; Goring-Morris and Gopher, 1983). Domestic barley at the Azraq sites has been interpreted variously as grown locally, grown at farming settlements elsewhere by the people who hunted at Asraq, or acquired by them through trade with farmers (Garrard *et al.*, 1996). Byrd (1992) suggests that, as sedentary farming populations began expanding, people who were still living as foragers came under pressure either to move away or to intensify their subsistence base by adopting components of the agricultural system that best suited their seasonal behaviour, such as herding. At Azraq, for example, the cereal/sheep/goat farming system was established a few centuries after PPNB people colonized the area.

The farming system does not seem to have included domestic cattle and pigs until later in the PPNB (Peters *et al.*, 1999, 2005; Zeder, 2005). The earliest evidence for them is found in the northern Levant and south-central Anatolia in the seventh millennium BC. Arguments for their domestication rest partly on the frequency of cattle and pig bones in faunal samples, but especially on diminution in animal size (Crabtree, 1993; Bar-Yosef and Meadow, 1995; Grigson, 1989; Kusatman, 1991). Thus Grittle in Turkey has many pigs, some of them large and others much smaller, the latter thought to be domestic (Stein, 1989). Perkins (1968) put the same argument for domestic cattle in the basal layers of Çatalhöyük: there were lots of them, some were very large but others much smaller, as small as cattle on later sites in Anatolia. Later studies by Ducos (1988) supported the thesis that domestic cattle were at the site from its inception. However, it now seems indisputable, on the basis of detailed studies of material from the current excavations, that the only domesticated livestock at the beginning of the site's occupation were dogs, sheep, and goats, with cattle, pigs, and deer being the main hunted taxa (Russell and Martin, 2005). Cattle played a critical role in ritual practices. Bulls, or at any rate large cattle, were selected for feasting, and parts of the animals consumed at ceremonies were incorporated into the fabric of the houses, sometimes visibly (skulls especially), sometimes hidden from view by being buried within houses (Hodder, 1987, 2005b; Mellaart, 1967).

The development of this agricultural system had huge implications for PPNB demography, economy, social behaviour, and ideologies (Kuijt, 2000). Regional surveys indicate that, wherever the agricultural system could be practised, populations grew dramatically through the PPNB period. Existing settlements got larger, new settlements budded off, and many of the major settlements developed as foci of exchange and ritual. Increasing standardization in artefacts points to the beginnings of craft specialization, with its implications of particular households having the surplus food to maintain the craftsman, or being able to acquire such food from other households

Fig. 4.12. The development of building architecture at Neolithic Beidha: (a) Subphase A1, PPNA; (b) Phase B, PPNA; (c) Phase C, PPNB; (d) non-domestic building in Subphase C1; (e) non-domestic building in Subphase C2; open circle – entrance; closed circle – room (after Byrd, 1994: fig. 4)



in return for goods. We know little of such exchange systems operating at the local level, between households and neighbouring communities, but there is much evidence for expanding systems of regional and interregional exchange, the best archaeological signatures of this being the black volcanic glass obsidian, found at settlements in the Levant and Zagros hundreds of kilometres from its sources in eastern Turkey. Other indicators of such exchange are marine shells from the Mediterranean and Red Sea and lumps of copper (surface nuggets, or ‘native’ copper) from the Negev and southern Jordan turning up at settlements far from the point of origin. A major expansion in personal ornament is another indicator of the increasing social differentiation in these PPNB village communities (Wright and Garrard, 2003), as well as evidence for the growing social importance of food (Wright, 2000).

Settlement morphologies provide further evidence for rapidly increasing social complexity, one of the most elegant studies being that of Beidha (Byrd, 1994; Fig. 4.12). In its first phase, PPNA Beidha was a collection of small round buildings without internal divisions and open courtyard spaces, the buildings being entered through two wide doors. In the second phase, structures were clustered more, with less public space between them. Entrance into individual structures was through a narrow door and down steps. The distribution of

hearts and storage facilities suggests the beginnings of separation between domestic and non-domestic spheres. The houses of the PPNB settlement, by contrast, were substantial rectangular structures with separate entrances to their upper and lower storeys. There are indicators that the upper storey was used for living and the lower storey for storage and production, and the latter activities were in turn carefully separated. There was a series of non-domestic structures, some entered through very narrow doors (Fig. 4.12d), others from the roof (Fig. 4.12e), some apparently for storage, others more for public ceremonial or ritual. Byrd concluded that these changes bear witness to the development of more restricted social networks. On the one hand households were increasingly private and autonomous, in control of their own production and storage. At the same time, distinctions were emerging between households, and community-wide binding mechanisms were developing, some economic, others ideological. The use of space was as highly structured and socially/ritually-circumscribed at Çatalhöyük (Hodder, 1999, 2005b). Stable isotope evidence for dietary differences in the population at this site might also be evidence for social differentiation in terms of differential access to different types of food, though the variability might reflect the fact that part of the population was regularly away from the community, for example herding livestock (Richards *et al.*, 2003a).

Burial customs and mobiliary art provide many signs of profound cognitive transformations in PPNB societies, suggestive of new roles both for the living and the dead (J. Cauvin, 2000). People were buried under floors or clay benches (Fig. 4.13). In the Levant in particular, the skulls of adults were sometimes removed for separate treatment (as noted earlier, a practice going back to Natufian times), having faces modelled on them at sites such as 'Ain Ghazal and Basta as well as, most famously, Jericho. Though we might assume that the faces were death masks, one study indicates that they were crafted to show the individual older than at the time of death (Arensburg and Herreshkovitz, 1988). They were placed variously on floors, in containers, or pits, as were figurines of stone, clay, or plaster, the latter sometimes of animals as in Natufian times but more commonly of humans, represented as either female or genderless. Though the details differ, similar trajectories towards increasing social differentiation and complex ideologies can be observed in the structural sequences of PPNB sites such as Nemrik (Kozlowski and Kempisty, 1990), Çayönü Tepesi (Aurenche and Calley, 1988; Schirmer, 1990), and Çatalhöyük, the scene of some of the largest and most impressive excavations of any Neolithic settlement in South-West Asia (Hodder, 1996, 2000, 2005a). Some archaeologists have looked to this archaeology for signs of opposing themes structuring societies such as life:death, male:female, and wild:domestic, but as Hodder (1987) argued from his detailed contextual analysis of Çatalhöyük,

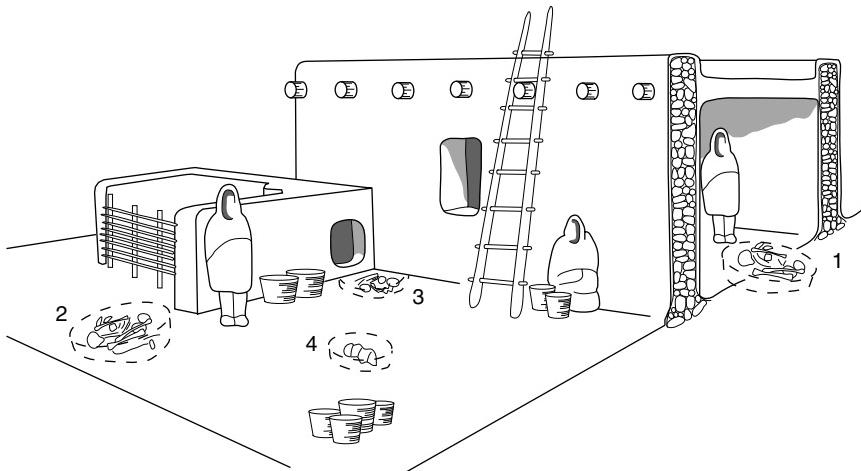


Fig. 4.13. Schematic representation of PPNB residential architecture and mortuary practices, including: (1) primary adult burial, skull removed, subfloor, and inside of structure; (2) primary adult burial, complete, extramural; (3) primary child burial, complete, under wall of structure; and (4) secondary burial cache of three skulls (after Kuijt and Goring-Morris, 2002: fig. 8).

the symbolism is probably more complex, ambiguous, and embodied with meaning in terms of social change. Women at Çatalhöyük, for example, are variously represented, misrepresented, or made invisible in different domains. The building of more stable houses, the establishment of increasingly defined places for living together, and the more elaborate and cultural treatment of the dead, all served to separate the domesticated landscape from the wild in ways completely foreign to the forager world-views described in Chapter 2.

Although mixed farming was first really established in the PPNB in South-West Asia, it was probably only in the Pottery Neolithic, from the later seventh millennium BC, that people really came to rely on agriculture across the region as a whole (Moore, 1982). The introduction of pottery coincided with important changes in the social context of agricultural practice, too. The finer fabrics could hold liquids, and soot on the earliest vessels at Abu Hureyra shows that they were certainly being used for cooking, enabling people now not just to roast meat on heated stones but also to mix flavours of meat, vegetables, and herbs in casserole-type dishes (Moore, 1995). With pottery, cereals could also be processed to make a range of softer, more digestible, foods—the teeth of the people at Abu Hureyra get far less abraded at the same time as pottery appears at the site (Molleson and Jones, 1991; Molleson *et al.*, 1993). One of the most important activities that was greatly facilitated

by being able to combine pottery and cereals was brewing, the magical process of fermentation presumably discovered as people observed that an old gruel left to stand 'did not spoil, but instead tasted sweet and had distinct effects on the mind and emotions' (Katz and Voigt, 1986: 33). In many traditional non-Western societies, communal beer-making and drinking are associated with a variety of activities from clearing forest, preparing ground for cultivation, and large-scale construction tasks, to marriages, funerals, and other rites of passage (D. Edwards, 1996). Beer certainly played an important role in the economy and ideology of the Sumerians, the first urban and literate societies of Mesopotamia, whose sign for 'beer' was made by drawing the sign for 'clay vessel' and filling the interior with linear markings.

Contemporary with the development of pottery were changes in animal husbandry. Like sheep and goats, cattle and pigs seem to have been valued by PPNB farmers primarily for their meat. During the course of the Pottery Neolithic, however, Near Eastern farmers began to exploit the potential first of sheep and goats, and then of cattle, not just for meat but also for the 'secondary products' of the live animal (Davis, 1986; Sherratt, 1981). Sheep and goats can be bred not just for meat but also for milk, which as cheese becomes a form of storable protein, and sheep could also provide wool. Cattle, grazers like sheep, were much harder to feed than sheep in terms of their fodder requirements, as well as needing more water, but they could provide far more meat and manure, as well as having the potential to produce milk for human consumption and pull ploughs and carts. Pottery facilitated the production of milk, yoghurt, and cheese. Pigs were valuable in a different way: because of their omnivorous feeding habits, and the fact that they are prolific breeders, they were a very effective way of turning the fruits of the forest into meat that could be either cured or consumed immediately.

The addition of pigs and cattle to the cereal/legume/sheep/goat mix during the PPNB in South-West Asia marked the emergence of the remarkably robust Eurasian agricultural system. Cereals and legumes fed both people and livestock. The livestock were vital for cultivation systems because of their manure and, in the case of cattle, pulling power. In time, the system proved to have enormous potential for feeding large numbers of people in a wide range of environments, from western Europe to South Asia, and from the Arctic Circle to the borders of the Sahara (and, with European colonialism, the New World). However, though in the literal sense flocks and herds were indeed a 'walking larder' (Clutton-Brock, 1989a), the fact that they were particularly valuable on the hoof meant they were ideally suited to become a principal mechanism by which social inequalities and hierarchies developed amongst many early farming communities keeping them. Livestock became capital that, more easily than land, could be accumulated through social alliances or warfare, and

expended through gift-giving, clientship, marriage dowries, feasting and so on, in the pursuit of wealth, prestige, and power.

CONCLUSION

Many archaeologists are increasingly confident about the origins of agriculture in South-West Asia. The model commonly proposed in the past fifteen years has been as follows: cereals were domesticated in the southern Levant, in the Jordan valley especially, in the mid-tenth millennium BC (the PPNA); sheep and goats were domesticated several centuries or a millennium later in the Zagros mountains; and the separate components then came together (a process begging many questions, of course) as PPNB mixed farming (e.g. Bar-Yosef and Belfer-Cohen, 1992; Bar-Yosef and Meadow, 1995; Hole, 1996). This coherent sequence of change, though, is almost certainly only a small part of the story.

First, we need to be mindful of the difference between evidence of absence and absence of evidence. The geographical focus of research in the region on which the story is based has been extremely restricted. Especially in recent years, a few places such as the Jordan valley in Israel and Jordan, and parts of Turkey, have been the scene of intensive research by many teams. This is in stark contrast to most of the Zagros, to say nothing of the rest of Iran east of the Zagros, an area at least as large as the Fertile Crescent.

Secondly, many Early Natufian societies were in fact already sedentary and living by systems of foraging that sometimes verged on husbandry in the major climatic warming that preceded the Holocene, c.13,000–11,000 BC. The climatic stresses of the ensuing Younger Dryas (c.11,000–9500 BC) forced some people to move and others to diversify, but it also propelled some Natufian communities to develop more intensive ways of managing particular plants (involving increasing sedentism, and less hunting), and perhaps others to concentrate heavily on hunting/herding sheep and goats. The sudden development of the more favourable Holocene climate c.9500 BC allowed many PPNA communities to return to a dependency on mixed foraging, but others committed to ever more deliberate forms of management of plants and animals that can be recognized as agriculture. These various components coalesced into the integrated system of mixed farming that sustained the Neolithic settlement explosion of the PPNB.

The South-West Asian evidence has three general contributions to make to the development of an overview of how and why foragers became farmers (Chapter 10). First, it shows that the dramatic climatic changes after the Last Glacial Maximum, across the Pleistocene–Holocene boundary, had a

profound impact on food resources available to foragers, and that this was certainly a critical force in shaping their behaviour. Second, it emphasizes that agriculture was not a sudden event but the outcome of long-lived processes made up of myriads of specific decisions by particular communities and individuals in particular about how to exploit the plants and animals on which they depended for their survival, along with all the related decisions—social, ideological, psychological—about living together in settled communities. From c.8500 bc PPNB villages were certainly practising mixed farming, using crops and animals that were more or less the same as their modern counterparts, and employing them together in ways that are recognizably the basis of the modern Eurasian farming system, yet the beginnings of husbandry-like behaviours can be detected amongst early Natufians almost 5,000 years earlier. The third point is that this ‘long’ sequence also shows that the transition from foraging to farming was not just a one-way process from simple to complex behaviours. Foragers in this region were clearly able to make choices about how to respond to major changes to their circumstances, rather than being constrained to take a particular course of action.

Furthermore, the South-West Asian sequence reminds us of how much we don’t know about such decision-making. As we document the change from communal to household systems of living from excavated house-plans, and from foraging to farming through flints, seeds, and bones, it is important to emphasize how little we understand about how things were really playing out at the level of the individual actors, in terms of their perceptions of their changing world and their place within it that provided the context for the decisions they took. How did relations change between males and females as gathering and hunting became cultivation and herding, and as the community or band gave way to the individual household as the unit of production and consumption and the principal theatre of human interaction? How did relations change between adults, the elderly, and children, as demographic structures and work roles changed? Or between the dead, the living, and the unborn, as societies came increasingly to depend on ‘delayed return’ ways of managing their landscape?

Because the deities worshipped (as far as we can tell) by PPNB societies are plants and animals that were living wild in the region before domestication, Jacques Cauvin (2000) has argued that Neolithic (i.e. agricultural) ideologies must have developed before formalized agriculture, in the PPNA. He then went further, to suggest that changing ideologies were the key factor stimulating subsistence change: in effect, that people began to think like farmers, so they became farmers. That PPNA societies were characterized by elaborate ritual and ideology is not in doubt, particularly given the evidence of sites like Jerf al-Ahmar and Göbekli Tepe. Most scholars, though, have tended to

regard the new ideologies as more likely to have developed hand in hand with new forms of subsistence (i.e. agriculture) rather than preceding them (Hodder, 2001), a debate I return to in Chapter 10. Trying to understand the development of the fertility-focused ideologies that commonly underpinned early agricultural communities such as those living in PPNB villages is a formidable challenge, but one that is certainly no less vital for modelling forager-farming transitions as understanding changing technologies, diets, house forms, animal and plant morphologies, and so on.

5

Central and South Asia: the Wheat/Rice Frontier

INTRODUCTION

This chapter intentionally overlaps with Chapter 4 in its geographical scope, as there is no clear boundary between South-West and South Asia. Western Asiatic landforms—mountain ranges, alluvial valleys, semi-arid steppe, and desert—extend eastwards from the Iranian plateau beyond the Caspian Sea into Turkmenistan in Central Asia, and there are similar environments in South Asia from Baluchistan (western Pakistan) and the Indus valley into north-west India as far east as the Aravalli hills (Fig. 5.1). Rainfall increases steadily moving eastwards across the vast and immensely fertile alluvial plains of northern India. The north-east (Bengal, Assam, Bhutan) is tropical, with tropical conditions also extending down the eastern coast of the peninsula and up the west coast as far as Bombay.

Today the great majority of the rural population of the region lives by agriculture, though many farmers also hunt game if they have the opportunity. The ‘Eurasian’ farming system predominates in the western part of the region: the cultivation of crops sown in the winter and harvested in the spring (*rabi*), such as barley, wheat, oats, lentils, chickpeas, jujube, mustard, and grass peas, integrated with animal husbandry based especially on sheep, goats, and cattle. A second system (*kharif*) takes advantage of the summer monsoon rains: crops are sown in the late spring at the start of the monsoon and harvested in the autumn. Rice (*Oryza sativa*) is the main summer or *kharif* crop (though millets and pulses are also key staples), grown wherever its considerable moisture needs can be met, commonly by rainfall in upland swidden systems and on the lowlands by flooding bunded or dyked fields in paddy systems. The systems are referred to as ‘dry’ and ‘wet’ rice farming respectively. Rice is the primary staple in the eastern or tropical zone receiving the greatest amount of summer monsoon rain. This extends from the Ganges (Ganga) valley eastwards through Assam into Myanmar (Burma) and East Asia. There are something like 100,000 varieties of domesticated Asian rice, but the main one grown in the region is *Oryza indica*. A wide range of

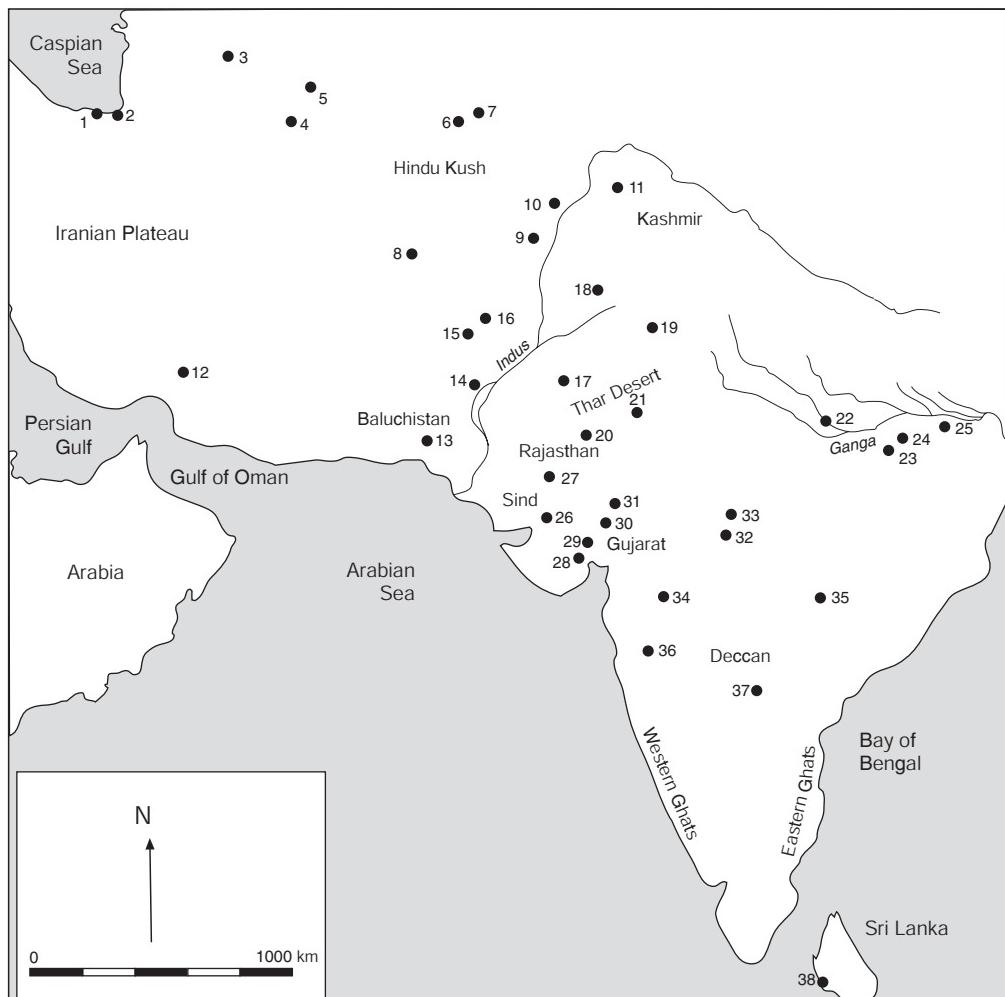


Fig. 5.1. Central and South Asia: principal sites and regions mentioned in Chapter 5.

Sites: 1. Ali Tappeh; 2. Belt Cave; 3. Jeitun; 4. Chagylli-depe; 5. Togolok-depe; 6. Kara Kamar I; 7. Ghar-i-Asp, Ghar-i-Mar; 8. Mundigak; 9. Bannu; 10. Aligrama; 11. Burzahom; 12. Tepe Gaz Tavila; 13. Balakot; 14. Mohenjo-daro; 15. Mehrgarh; 16. Pirak; 17. Ganweriwala; 18. Harappa; 19. Rakhigarhi; 20. Tilwara; 21. Bagor; 22. Sarai-Nahar-Rai; 23. Belan Valley; Baghor, Chopani-Mando, Damdama, Ghagharia, Koldihwa, Lekhahia; Mahagara; 24. Kunjhun, Son Valley; 25. Chirband; 26. Surkotada; 27. Dholavira; 28. Rangpur; 29. Lothal; 30. Langhnaj; 31. Ahar; 32. Adamgarh; 33. Bhimbetka; 34. Daimabad; 35. Adam; 36. Inamgaon; 37. Utnur; 38. Beli-Lena cave

millets is also grown as summer crops in rain-fed systems throughout the semi-arid tropical regions of South Asia, including sorghum or 'great millet', finger millet, pearl or bullrush millet, proso or common millet, foxtail millet, bristley foxtail, browntop millet, kodo millet, little millet, and sawa millet. The millets are particularly valuable because they tolerate a range of soil types, and

have short warm-weather growing seasons. Other *kharif* crops include dates and native Indian summer pulses including pea, green gram or mungbean, black gram, horsegram, pigeonpea, and hyacinth bean. This panoply of food plants is derived from different source regions (Table 5.1), so a particular focus of scholarship critical to questions of agricultural origins has been on determining when and in what circumstances exotic crops reached South Asia and indigenous plants were taken into cultivation (Fuller, 2002a).

Most farmers keep livestock, especially the ubiquitous humped zebu cow *Bos indicus*. There are also numerous groups of specialist pastoralists in the arid zone, such as the Kuchi of Sind and Afghanistan. Although they cultivate land by their base settlements, most practise long-distance transhumance, leaving part of the community at home to guard and tend the crops, the rest of the community returning especially at harvest. Pastoral groups such as the Barhval also operate in intensively farmed regions like Gujarat, selling milk, butter, wool, and livestock in local agricultural markets and being paid by farmers to pen their stock on the arable land in order to manure it.

Many desert, hill, and forest regions of central and southern India (the region generally known as the Deccan) have also sustained people living mainly by hunting and gathering until very recent times: groups such as the Van Vagrīs, Kal Beliyas, Sansis, and Bhils of the Thar desert; the Yanadis, Chenchus, and Boyas of the Eastern Ghats; and the Veddas in Sri Lanka (Lee and Daly, 1999). Murty (1985) listed almost 100 plants commonly exploited by the Eastern Ghats foragers for food: tubers, rhizomes, leaves, fruits, berries, pods, flowers, seeds, and nuts. Most are eaten raw, though a few needed roasting to make them edible. Vishnu-Mittre (1985) calculated that they exploit a quarter of India's c.20,000 wild plants for non-food purposes: tools and poisons for hunting; nets, floats, harpoons, poison, and intoxicants for fishing; basketry and cloth; unguents and dyes; and some 3,500 plants for medicines. Hunter-gatherer groups generally traded animal skins, baskets, honey, and other forest products with neighbouring farmers in return for iron axes and knives, cloth, tobacco, and sometimes cereals. The Van Vagrīs, for example, who live in small bands of 3–5 families, use nets, traps, bows and arrows, guns, and iron-tipped spears to hunt a wide variety of game: large game such as blackbuck, nilgai, and gazelle, though these are rare today; and smaller game such as hare, porcupine, monitor lizard, and birds. They practise little plant cultivation because it needs elaborate processing, preferring to trade meat with neighbouring farmers for vegetables, or guarding farmers' fields from wild animals and birds during winter in return for grain (Misra and Rajaguru, 1989: 318).

Compared with South-West Asia, research on agricultural transitions in Central and South Asia was limited through the 1960s and much of the 1970s. The reports on India for the 1969 London seminar on the domestication and

Table 5.1. Some common crops in South Asian agriculture, and their assumed origins

Crops of probable South-West Asian origin	
<i>Cicer arietinum</i>	Chickpea
<i>Cucumis melo</i>	Melon
<i>Hordeum vulgare</i>	Barley
<i>Lathyrus sativus</i>	Grass pea
<i>Lens culinaris</i>	Lentil
<i>Linum usitatissimum</i>	Flax
<i>Pisum sativum</i>	Pea
<i>Triticum dicoccum</i>	Emmer
<i>Triticum aestivum</i>	Bread wheat
Crops of probable African origin	
<i>Cyamopsis tetragonolobus</i>	Cluster bean
<i>Eleusine corocana</i>	Finger millet
<i>Gossypium herbaceum</i>	Asiatic cotton
<i>Lablab purpureus</i>	Hyacinth bean
<i>Pennisetum glaucum</i>	Pearl millet
<i>Ricinus communis</i>	Castor
<i>Sorghum bicolor</i>	Sorghum
<i>Vigna unguiculata</i>	Cow pea
Crops of probable South Asian origin	
<i>Brachiaria ramosa</i>	Browntop millet
<i>Cajanus cajan</i>	Pigeonpea
<i>Echinochloa colona</i>	Sawa millet
<i>Gossypium arboreum</i>	Tree cotton
<i>Macrotyloma uniflorum</i>	Horsegram
<i>Panicum sumatrense</i>	Little millet
<i>Paspalum scrobiculatum</i>	Kodo millet
<i>Sesamum indicum</i>	Sesame
<i>Setaria pumila</i>	Yellow foxtail millet
<i>Setaria verticillata</i>	Bristley foxtail
<i>Vigna aconitifolia</i>	Golden gram
<i>Vigna mungo</i>	Black gram
<i>Vigna radiata</i>	Green gram
Crops of probable varied origin (East Asia, South-East Asia, North-East India)	
<i>Canabis sativa</i>	Hemp
<i>Oriza sativa</i>	Rice
<i>Panicum miliaceum</i>	Proso millet
<i>Saccharum officinarum</i>	Sugarcane
<i>Setaria italica</i>	Foxtail millet

Source: Fuller, 2002a; Fuller and Madella, 2001.

exploitation of plants and animals focused largely on data from the Harappan or Indus state or civilization, which developed in the Indus valley in the middle of the third millennium BC, and on the preceding Chalcolithic cultures of Baluchistan to the west (Allchin, 1969a, 1969b). The same is true of Hutchinson's essay on India in another survey of the early history of agriculture a few years later (Hutchinson, 1976) and Clason's summary of the archaeozoological evidence the following year (Clason, 1977). Far less is understood about the nature of late Pleistocene and early Holocene settlement in this region than in South-West Asia. Until recently the beginnings of farming systems in the tropical zone of southern Asia have also been poorly researched compared with East and South-East Asia, the radiocarbon chronologies still being problematic. Recent discussions of the origins of agriculture have had little or more commonly nothing to say about what happened in this part of the world (e.g. Cowan and Watson, 1992; Gebauer and Price, 1992a; Harlan, 1995; B. D. Smith, 1995a), despite its potential importance as the interface between the Eurasian and Asian farming systems and the considerable range of high-quality fieldwork now being published from the region.

Furthermore, wild populations of sheep, goats, cattle, pigs, barley, and legumes almost certainly existed throughout Central Asia into northern India in the late Pleistocene (Chapter 4, p. 108). Wild cattle (the aurochs *Bos primigenius*, and its smaller Indian sub-species *Bos namadicus*, the gaur) were endemic to the entire region (Grigson, 1985). Wild species of perennial rice (such as *Oryza rufipogon*) were indigenous to the tropical wet evergreen forests of South Asia, such as in the Western Ghats of the Indian peninsula and the lower Ganga valley in the north-east (Glover, 1985; Glover and Higham, 1996; Whyte, 1985), and as Table 5.1 shows, a wide range of millets and pulses is indigenous to peninsular India. Seen in this light, it is surprising that, until very recently, most general studies of the transition to farming in this region have invariably started from the assumption that agriculture must have begun here because the Eurasian system of farming (and farmers) spread eastwards from South-West Asia and the Asian system spread westwards from China (e.g. Bellwood and Barnes, 1993; Diamond, 1997; Fairervis, 1971; Harlan, 1995), rather than the alternative hypothesis, that given the range of potential domesticates, agricultural systems are just as likely to have developed independently here as in South-West Asia and China.

One of the difficulties in studying the development of farming in the region, in India especially, is caused by terminologies. Sites with geometric microliths, for example, are invariably termed Mesolithic and classified as sites of foragers, but excavations show that many people using this technology in the Holocene herded domestic animals, sometimes more than they hunted wild animals. Equally, sites with early handmade pottery were invariably termed

Neolithic and ascribed automatically to farmers, but it is now clear that such pottery was used variously by foragers, forager-farmers, and farmers. Metal tools are regarded as the definitive artefacts of Chalcolithic or Copper Age culture, associated generally with wheel-made pottery, but in some regions Chalcolithic refers to complex, stratified, metal-using agricultural societies, in others to mobile stone-using pastoralist or pastoralist-forager societies. These difficulties are frequently compounded by problematical radiocarbon dates from particular sites. In this chapter, following a comment on late Pleistocene settlement, I have synthesized the data in three broad chronological segments that I am terming for convenience the 'early', 'middle', and 'later' phases of the transition to farming in the region. The first phase is from c.9500 to c.6000 BC, approximately the equivalent of the Pre-Pottery Neolithic in South-West Asia. The next phase is from c.6000 BC to the threshold of the Harappan state c.3000 BC. The last phase is from the period of the Harappan state to the first millennium BC.

LATE PLEISTOCENE SETTLEMENT, c.20,000–9500 BC

Palaeoenvironmental data are still very limited for the region, but there seems to be a general consensus that the late Pleistocene was characterized by considerable aridity, as in South-West Asia, with the south-west monsoons being much weaker than today (Allchin and Goudie, 1974; Meadow, 1989a). The effect of the south-west monsoons strengthened after the Last Glacial Maximum, bringing greater seasonality and increased summer precipitation (Fontugne and Duplessy, 1986). Foragers moved in and out of the Thar desert in response to these fluctuations in aridity, the desert probably being abandoned entirely in the LGM, only being reoccupied about 14,000–13,000 years ago (Allchin *et al.*, 1978; Misra, 1989). Interleaved sandy, silty, and clayey layers in the Didwana salt lake are a record of rapidly changing environments at this time, the reoccupation of the desert taking place in an episode of climatic amelioration (Misra and Rajaguru, 1989) contemporary with the interstadial conditions that allowed the colonization of the steppe zone by early Natufians to the west.

Lithic industries comparable to those of the Zagros mountains have been found at several caves in north-east Iran, such as Ali Tappeh on the edge of the Caspian Sea (McBurney, 1968), and Ghar-i-Asp (Horse Cave, or Aq Kupruk II) in Afghanistan (Davis, 1978; Dupree, 1972). The Afghan caves were investigated before the fighting between Afghan rebels and the former Soviet Union, the bones were studied only provisionally by Dexter Perkins, and there are uncertainties over dating. Ghar-i-Asp has a date of about 15,000 BC,

together with a non-geometric microlithic industry of a kind that developed further west in the early Holocene. Davis (1978) accepted the Ghar-i-Asp date, whereas Russian scholars, on the basis of comparisons with sites investigated further north, suggested that it was probably too early (Vinograd and Ranov, 1988). Either way, the site was being used by people who were hunting wild sheep and goats, together with cattle and red deer (Meadow, 1989b). Today the range of the wild argali sheep *Ovis ammon* and the Siberian ibex *Capra ibex siberica* extends into the Hindu Kush, whereas the smaller wild urial sheep *Ovis orientalis* and wild bezoar goat *Capra hircus aegagrus* are only found in Afghanistan further west. The sheep and goat bones from Ghar-i-Asp studied by Dexter Perkins were small. Meadows accepts Perkins's conclusion that the wild sheep being hunted from Ghar-i-Asp in the late Pleistocene were argali, but disagrees with his identification of the bezoar goat, suggesting from (admittedly later) horn core evidence that the wild goats were probably Siberian ibex. Sheep and gazelle were also hunted at Kara Kamar I (Coon, 1957). There is no information on plant gathering, though there were simple grinding stones at Ghar-i-Asp and wild barley grows in the locality today. The impression is that late Pleistocene settlement here was much as in the Zagros, based primarily on logistical hunting, with little sedentism.

The final Palaeolithic industries of India are generally microlithic, with many backed blades. As in Afghanistan, most sites known post-date the LGM. Evidence is best from the southern tributaries of the Ganga such as the Belan and Son (Clark and Williams, 1986). Microwear studies of the lithics from Baghor III in the Son valley found evidence for polishes produced by curing meat, hide, bone, and antler, but most of the blades were being used to cut plant materials (Misra, 1989), suggesting that, as we might expect, gathering was more important in the tropical zone than in the mountains and steppes of Central Asia.

Though the evidence is very sparse, therefore, there is no evidence as yet for any of the 'proto-agricultural' subsistence behaviours observed in the Levant and (much more speculatively) the Zagros before the transition to the Holocene. Given the quality of the data, though, it has to be recognized that this may be more a case of absence of evidence than evidence of absence.

FARMERS IN CENTRAL ASIA AND NORTH-WEST INDIA c.9500–6000 BC

The Caspian Sea littoral and the Hindu Kush mountains continued to be used by people hunting sheep, goats, and gazelle at sites like Belt Cave (Coon, 1951; Dupree and Howe, 1963), but it is also possible that herding started

to develop early in the Holocene (we simply have no evidence for what plants were exploited, and how). Ghar-i-Mar (Snake Cave, or Aq Kupruk I) produced radiocarbon dates from the 1950s excavations that calibrated would be *c.*9000 and 7500 bc. In his brief note on the fauna, Perkins (1972) argued from horn-core morphology and skeletal part size that both domesticated sheep and goats were present as well as wild cattle, gazelle, red deer, and an equid. Unfortunately the material is not now accessible for study, and from a reconsideration of Perkins's notes, Meadow (1989b) concluded that it was impossible to judge the strength of the case.

Ghar-i-Mar is outside the modern range of the mouflon sheep, though well inside the range of the urial and argali. The mouflon's range may well have extended right across Afghanistan in the early Holocene, but the case for the mouflon being the only possible ancestor of domesticated sheep rests on the assumption that all breeds of sheep tested cytogenetically include direct descendants of early domestic sheep in Central Asia (Meadow, 1986: 60, 1989b: 34), and it is possible that locally domesticated animals could have been replaced later by imported breeds. Indeed, the occurrence of both large and small domestic sheep at Harappan sites suggests that such intermixing may have been taking place then (Meadow, 1996: 403), at a time when (as discussed later in the chapter) new plant crops—the African millets—were also being introduced into South Asia (though not the Harappan zone) by trade with South-West Asia and Africa. Local domestication of wild sheep and goat populations in Central Asia therefore cannot be ruled out on the archaeological evidence, and DNA patterning in modern sheep and goat populations also points to a few geographically separated domestication events rather than single domestication events in South-West Asia (Hiendleder *et al.*, 2002; Luikart *et al.*, 2001). The same levels at Ghar-i-Mar also contained querns, pounders, stone bowls, and sickles, so presumably plants of some kind were being processed (Shaffer, 1978).

By perhaps the middle of the seventh millennium bc (the dates are uncertain, as the samples were dated a long time ago), the people at Belt Cave and Ghar-i-Mar used a stone technology that included a variety of querns, grinders, stone bowls, stone axes, pressure-flaked points, and sickle blades, as well as simple pottery fired at low temperatures (Coon, 1957; Dales, 1965; Shaffer, 1978). Charred grain was also found in these levels at Ghar-i-Mar, but it has not been identified. The fauna included domestic sheep and goats, gazelle, red deer, and cattle, the wild or domestic status of the latter remaining uncertain. However, it seems clear that by the later seventh millennium bc the people in the Hindu Kush were combining hunting and gathering with herding and, probably, small-scale cereal cultivation.



Fig. 5.2. Plan of Jeitun (after Sarianidi, 1992: fig. 1)

By this time, though, there were certainly substantial agricultural villages to the west in Turkmenistan. The best known is Jeitun (Fig. 5.2), first excavated in the 1950s and then reinvestigated in the 1990s (Harris and Gosden, 1996; Harris *et al.*, 1993; Masson, 1961). Other sites include Chagylli-depe and Togolok-depe (Sarianidi, 1992). The 1950s excavations at Jeitun revealed some twenty small rectangular dwellings: they were single-roomed, each with a hearth and storage silos. The later excavations recovered seeds and other remains of einkorn, emmer, and what is probably bread wheat, naked and hulled six-row barley, and various other weedy plants associated with cereal fields. The nature of the harvest debris indicated that the cereal ears were harvested first, and then the stubble at a second stage. Use wear analysis confirmed that the sickles were used for harvesting cereals and a variety of mortars and pestles for processing them. These Turkmenistan farming settlements are located at the edge of the piedmont in a region of low rainfall today, marginal for cereal cultivation, and environmental studies indicate that the rainfall regime then was much the same as it is today. On the evidence of rush seeds in the crop residues, Neolithic farmers coped with the aridity of the region by growing their crops on marshy soils where the water table was high, to make use of groundwater moisture, like many PPNB farmers in South-West Asia.

The analysis of the Jeitun fauna by Kasparov (reported in Harris *et al.*, 1993) indicated the hunting of wild sheep and goats (he suggested urials and bezoars

respectively) and gazelle, and the herding of domestic sheep and goats, confirmation of the latter activity coming from the discovery of goat droppings in the yards. The high proportion of juvenile animals in the domestic flock indicates a husbandry system geared to meat production, and use wear studies of the stone blades show that many were used for meat butchery and others for working leather. The meatier parts of the carcass were processed inside the dwellings and the extremity bones needed for tool manufacture kept outside.

David Harris discusses the case for and against agriculture developing independently in Turkmenistan (Harris and Gosden, 1996; Harris *et al.*, 1993). The region is within the modern range of wild wheats and barleys, and the reliance on einkorn at Jeitun is unusual compared with South-West Asia, where emmer is invariably the main crop at PPN sites. The contemporary site of Mehrgarh in Baluchistan considered below is also different again, with a predominance of free-threshing hexaploid wheats, emphasizing the distinctiveness of early farming in Turkmenistan. However, despite this evidence for distinct regional differences in the early practice of the Eurasian crop system, Harris suggests that cereals were probably not domesticated independently in Turkmenistan because the supposed wild ancestor of einkorn, *Triticum boeoticum*, is not found in the region today. He reaches a similar conclusion regarding sheep domestication, again on the evidence of the modern distribution of the mouflon, the supposed wild progenitor of sheep, because the urial, rather than the mouflon, is found in the region today.

The implication of this argument is that mixed farming must have begun at Jeitun in the later seventh millennium BC as part of a dramatic expansion of PPNB farming from South-West Asia. Harris does not speculate as to the nature of this expansion, which would presumably imply either the spread of farmers from the Zagros mountains across the Iranian plateau in search of new land, or the adoption of farming by the local Turkmenistan hunter-gatherer population through trade contact with farmers elsewhere (again, presumably on the eastern side of the Zagros in Iran). Interestingly, though, the pottery made by the Jeitun farmers has many more similarities with that of the Hindu Kush caves to the east than with that of Pottery Neolithic sites in the Zagros or on the Iranian plateau. The diffusion model would presumably envisage three millennia of hunting and gathering here followed by the adoption of PPNB-type farming by local foragers from contact with PPNB farmers, or the displacement of local foragers by incoming PPNB farmers. The main problem, however, is that we do not know what was happening in Turkmenistan between, say, 9500 and 6500 BC, that is, before the appearance of pottery-using farmers at Jeitun. It is quite possible that Jeitun represents the culmination of a local trajectory of changing systems of cereal, sheep, and goat exploitation that has yet to be discovered, a Turkmenistan PPNA. The

Ghar-i-Mar evidence suggests that such a sequence may be more rather than less likely to be discovered in the future.

The most important early farming settlement in Baluchistan is Mehrgarh, about 100 kilometres south-east of Quetta, at the foot of the Suleiman mountains at the point where the Bolan pass opens out onto the Kachi plain (Jarrige, 1984; Jarrige and Lechevallier, 1979, 1980; Jarrige and Meadow, 1980; Lechevallier and Quivron, 1981; Shaffer and Thapar, 1992). Excavations in the oldest of a series of mounds here found a deep sequence—some 9 metres—of aceramic Neolithic occupation, in which four main phases of occupation were recognized. Precisely when settlement began at Mehrgarh is unclear. The top level (1), with a few sherds of Jeitun-like pottery, has been dated to the fifth millennium BC. The third level has radiocarbon dates which (calibrated) suggest occupation in the eighth millennium BC. Hence the earliest level (4) should go back certainly to the eighth and possibly to the ninth millennium BC, contemporary with the beginnings of the PPNB in South-West Asia. Furthermore, unlike the simple one-roomed dwellings at Jeitun, from the first phase at Mehrgarh there were complex multi-roomed structures made of unmoulded unbaked mud-brick (Fig. 5.3).

The building exposed from the first phase consisted of a series of rooms within a complex measuring six by 3.5 metres. The walls survived to a height of almost a metre, but there were no doorways, or domestic artefacts, suggesting that the structure was designed for storage, perhaps communally organized.

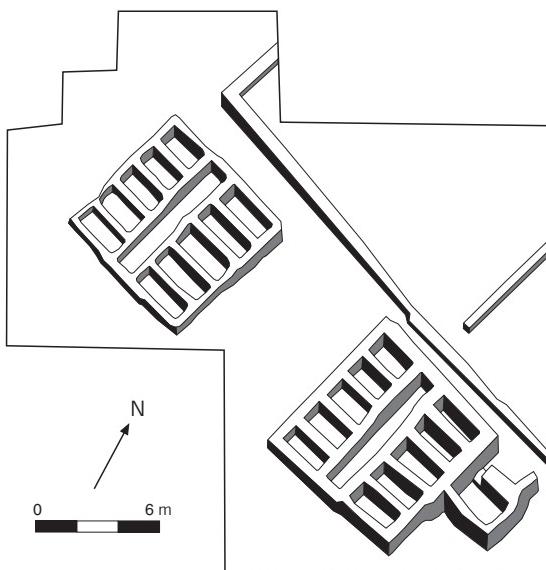


Fig. 5.3. Mehrgarh: buildings of Period IB, fifth millennium BC (after Jarrige, 1984: fig. 4.1)

The dead were formally separated from the living in cemeteries. People were buried flexed, at different orientations, accompanied by an array of grave-goods such as shell pendants, bead necklaces, bone rings, and baskets. One skeleton was buried accompanied by a necklace of lapis lazuli and turquoise beads, the materials from which must have originated in Iran, together with a shell and stone bracelet, and a stone chisel. There were also textile traces on the body.

The people living at Merhgarh were plant cultivators. The plant remains consist mainly of impressions in mud brick, though there are also carbonized remains, with naked six-row barley the commonest plant represented in both (Costantini, 1984, 1986; Costantini and Costantini Biasini, 1985). However, other crops found in the first phase included einkorn, emmer, hard or durum wheat, two-row and six-row hulled barley, and date (*Phoenix dactylifera*). The only wild plants found in this level were the jujube fruit (*Ziziphus jujuba*) and morphologically wild grains of two-row barley. Wild barley grows around the site today, and Costantini argued from the distinctive character of the naked six-row barley grains (90 per cent of the plant remains in the basal levels) that barley was probably domesticated locally. The wild wheats do not grow in the region today, but the durum wheat, fully domesticated from the outset according to morphological criteria, could have developed through hybridization with the wheat-relative *Aegilops squarrosa*. Dates are also native to the region. In short, he suggests, there seems no reason to argue that the crops being grown by the first farmers at Mehrgarh had to be derived as domesticates from South-West Asia introduced by exchange or direct population displacement. Interestingly, a study of the morphologies of the teeth of the human population at Mehrgarh also found them to imply a distinct breeding population, quite distinct from that of South-West Asia (Lukacs, 1989; Lukacs and Minderman, 1992).

Hunting rather than herding seems to have been the other main subsistence pursuit (Meadow, 1981, 1984a, 1984b, 1986, 1989a, 1996, 1998). The greater part of the meat consumed by the first inhabitants of the site was from game, especially gazelle and other medium-size herbivores such as barasingha or swamp deer (*Cervus duvaucelii*), blackbuck (*Antelope cervicapra*), chital or spotted deer (*Axis axis*), wild ass (*Equus hemionus*), wild goat, and sheep. Other animals hunted included boar, bigger animals such as the eland-like nilgai (*Boselaphus tragocamelus*), wild cattle (presumably *Bos namadicus*), water buffalo, and elephant, and smaller game such as fox, jungle cat, and jackal. The domestic animals represented were dog, sheep and goats, and cattle, the latter identified as the humped zebu *Bos indicus* on the basis of skull morphology and dorsal vertebrae. The presence of both domestic and wild cattle, sheep, and goats at aceramic Mehrgarh is posited by Meadow on the grounds that there are bones of all three animals in the early levels that

are morphologically and metrically identical to the bones of the (certainly) domestic species in later periods of occupation, alongside (in both cases) the bones of much larger animals that are assumed to be wild. The main stock were sheep and goats, though cattle would have provided as much meat, the mortality data indicating that most of the livestock was killed as it attained full growth. Further evidence that domestic sheep and goats were being kept by the community consisted of their hoof imprints in the clay floors. The gazelle/goat mix in this first phase of occupation is reminiscent of many PPNA sites in South-West Asia.

In the succeeding phases of Neolithic occupation, the role of game in the diet consistently decreased and zebu came to be the major livestock (Meadow, 1984*a* and *b*; Fig. 5.4). The amount of meat being produced from the zebu herd suggests that the large communal buildings may have been used as centres for storing meat and distributing it to the community. Another trend

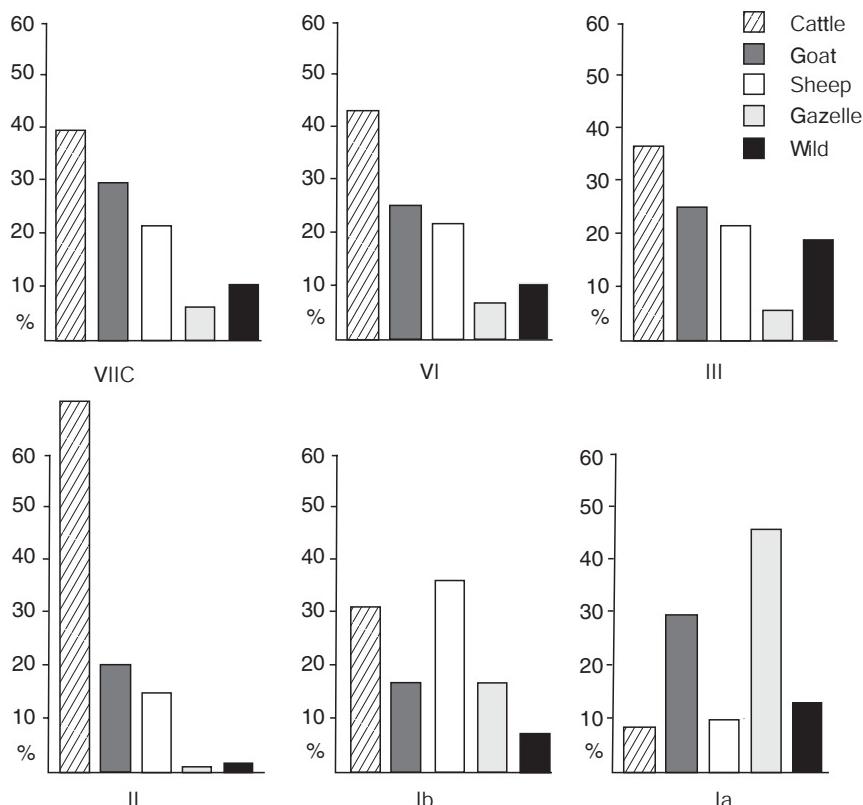


Fig. 5.4. Changing frequencies of fauna at Mehrgarh; VIIIC to Ia refer to phases of the site's occupation (after Meadow, 1989*b*)

observed was a changing relationship between sheep and goats: goats were more numerous than sheep in the basal levels, then sheep became far more numerous than goats, but in the later levels the numbers of sheep and goats were roughly equal. At the same time, the size of cattle and sheep diminished rapidly, whereas goat size remained relatively stable (Fig. 5.5). Meadow concluded that fully domestic goats were present at Mehrgarh from the outset, whereas the process of domesticating cattle and sheep was still in train through the initial phases of occupation. Interestingly, one of the earliest burials at Mehrgarh was of an individual laid to rest with a sickle by the head and the body of a goat at his or her feet. The grave-goods of another prestigious individual buried c.5500 BC included a bracelet of copper beads, one of which contained a piece of cotton (Moulherat *et al.*, 2002). Cotton has usually been thought to have been domesticated in the Harappan period, and its appearance in Neolithic Mehrgarh is yet another indicator of the innovative and distinctive nature of the early practice of the Eurasian farming system in this part of South Asia.

Like the plant and animal husbandry systems, the harvesting technologies at Mehrgarh were distinctive with respect to those of South-West Asia. The technology included geometric microliths such as those used by the late Pleistocene and early Holocene foragers of the Zagros and Turkmenistan. Although it is normally assumed that these were armatures for arrowheads, some of them in the first level at Mehrgarh had silica gloss indicating that they were being used in this instance as sickles. Furthermore, although 'normal' sickle blades were also found, including ones with traces of bitumen attached to them, they were much rarer than microliths with sickle gloss. This unusual preference for making sickles out of microliths (presumably they were set saw-edged into wooden or antler handles), rather than parallel-sided blades as in South-West Asia, became more common over time (Lechevallier, 1984). The Mehrgarh community also used polished axes and adzes, stone bowls, perforated stones that are probably the weights for digging sticks, and asphalt-coated baskets.

In short, though the house architecture and cemeteries bear some resemblance to those of PPNB settlements in South-West Asia, there were significant differences in the nature of the farming systems practised, and the technologies used. In combination, the evidence suggests that it is at least as reasonable to interpret Mehrgarh in terms of a separate process of domestication taking place in this part of South Asia, in parallel with that of South-West Asia, as it is to accept the orthodox assumption that Mehrgarh agriculture must automatically be regarded as an offshoot of South-West Asian agriculture, an eastwards colonization of PPNB farmers from the Zagros or some kind of acculturation process. This reading of the data chimes with the study by Loftus *et al.*

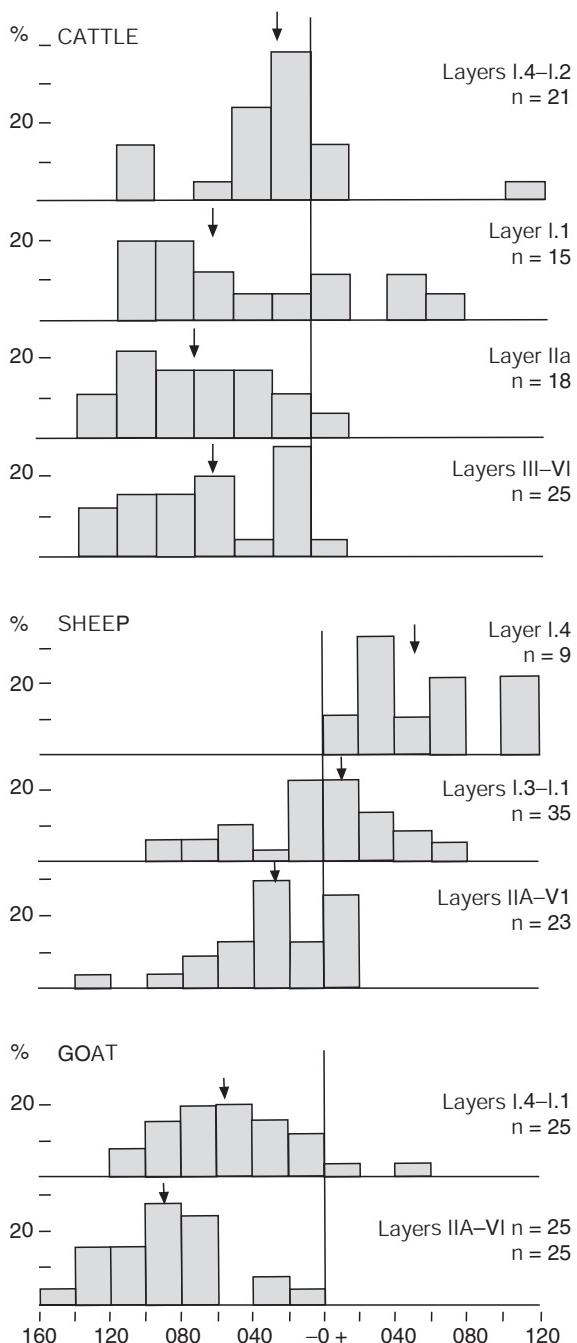


Fig. 5.5. Size changes of cattle, sheep, and goats at Neolithic and Chalcolithic Mehrgarh, plotted according to the difference of logarithms technique (the arrows mark the median size); the older (Neolithic) layers are at the top of each bar chart. Cattle decrease rapidly in size at the beginning of the sequence and then stabilize; sheep decrease dramatically and consistently over time; goats remain relatively stable (after Meadow, 1984b: fig. 6.3 and 1986: figs. 1, 2)

(1994) of mitochondrial DNA in modern cattle. Their analyses of degrees of genetic similarities and differences between six European taurine breeds, three zebu and one taurine breed from Africa, and three zebu breeds from India, concluded that the African and European cattle were from one lineage but that Indian cattle were quite separate, with a divergence date at least 200,000 years ago. This clearly implies separate domestication events for the different sub-species of *Bos primigenius*, including the Indian *Bos namadicus*. The work of Hanotte *et al.* (2002) points to the initial domestication of zebu cattle in South Asia. The evidence for communal food storage, elaborate ideologies, and positions of authority in Mehrgarh society also suggests that the site is unlikely to represent the initial stage of agricultural practice in Baluchistan.

EARLY HOLOCENE FORAGERS IN SOUTH ASIA, c.9500–6000 BC

In the Indian sub-continent, the earliest evidence for the nature of Holocene subsistence is from the Beli-Lena cave in Sri Lanka, dated to the opening millennia of the Holocene and situated on the edge of tropical evergreen forest by the Kelaniya river (Kajale, 1989, 1991). The food remains indicate broad-spectrum hunting, fishing, and gathering. The mammalian fauna included animals of a wide variety of habitats and sizes (young elephant, gaur, water buffalo, sloth bear, boar, sambar, spotted deer, muntjac, chevrotain, hare, giant squirrel, flying squirrel, pangolin, monitor lizard, terrapin, and tortoise), though the smaller mammals were especially numerous. The people also collected shellfish and crabs, and fished. Unusually for these environments, too, plant food remains were also recovered from the site: wild bread fruit, wild bananas, and *Canarium zeylanicum* nuts.

Numerous Holocene sites with geometric microliths are known throughout the Indian peninsula, but few are dated satisfactorily to this phase. Sarai-Nahar-Rai in the central Ganga valley produced a radiocarbon date from uncharred bone of c.8000 BC (so nearer 9000 BC calibrated), but material similarities suggest that it is more likely to be contemporary with a series of sites dated primarily to the ensuing phase of settlement (Sharma, 1973). A burial at Damdama in the Belan valley has yielded an AMS (Accelerator Mass Spectrometer) date of c.6800 BC (J. Lukacs, *pers. comm.*). The nearby sites of Mahagara and Chopani-Mando, probably of the same antiquity, have post-hole evidence for flimsy shelters, and the food remains reported include wild cattle, wild sheep, and wild rice (Sharma, 1985), though the identifications remain uncertain. In the same valley Baghor II, an open site, and the Ghagharia rock shelter, have similar evidence for simple lean-to shelters

and are probably broadly contemporary (Clark and Williams, 1986). Pollen analyses indicate a rather open grassland landscape at this time, ideal for grazing animals, and yielding edible grasses and cereals for human collectors as well, whilst riverside forests would have provided edible roots and fruits. Bones reported at these sites commonly include gaur, buffalo, sambar, chitelle, gazelle, hog deer, nilgai, fox, and jackal, together sometimes with tortoise and fish. The technology used included geometric microliths, digging sticks weighted with perforated stones, sling balls, hammer-stones (thought to be for splitting bone), and mortars and pestles, though stains on the latter show they were used for grinding pigments as well as for processing plant food. Whilst the individual sites are often problematical, the cumulative evidence suggests that the Indian sub-continent was well populated by seasonally mobile foragers through the early Holocene. There is reasonably convincing evidence that the early Holocene climate was significantly wetter than today's, with high winter as well as summer rainfall (Swain *et al.*, 1983), allowing foragers at this time to recolonize areas such as the Thar desert (Misra, 1989). The riverine resources of the Indus valley were also a focus of settlement (Cleland, 1986).

Ghagharia has rock paintings of the Indian Mesolithic style termed Vindhyan, suggesting that some of the art dates to this phase, even though most of it is probably rather later. Several thousand rock art sites are known, especially in Madhya Pradesh and central Mirzapur (Mathpal, 1985; Misra, 1985; Wakankar and Brooks, 1976). One of the richest locations is Bhimbetka in Madhya Pradesh (Misra and Mathpal, 1979; Fig. 5.6). The paintings are generally in red and white. Most images show game standing, sitting, grazing, walking, and running, together with scenes of hunting, both single encounters with single animals and communal hunts of herds. The technologies shown include the lance, bow and arrow, and traps. Other images depict the collection of plant food and honey, and small conical huts. There are also examples of dancing men and women, nude females, and men walking in file, which, combined with semi-mythological scenes such as the horned boar repeated in several images (Fig. 5.6: 8), are resonant of a rich animistic foraging ideology, elaborate initiation rites for particular age and gender groups, and so on.

AVAILABILITY, SUBSTITUTION, RESISTANCE: FARMERS, HERDERS, AND HUNTERS, c.6000–3000 BC

By the sixth and fifth millennia BC, agricultural villages were widely dispersed throughout eastern Iran, Turkmenistan, and Baluchistan (Jarrige, 1981; Kohl, 1981; Mashkour *et al.*, 1999; Shaffer, 1978). There are increasing signs of social hierarchy, the production and control of surplus foodstuffs, specialized craft



Fig. 5.6. Mesolithic rock art, India: 1. 'hunting expedition', Lakhajur hill, Bhimbetka; 2. 'facing a porcupine', Dhonkwa shelter, Mirzapur; 3. 'faced by a tiger', Lahari shelter, Mirzapur; 4. 'pointing out an animal', Bhimbetka; 5. 'ready to march', Bhimbetka; 6. 'chasing buffaloes', Bhimbetka; 7. 'after a fox', Jaora; 8. 'rounding up the giant', Ghormangar shelter, Mirzapur; 9. 'the unlucky stag', Bhimbetka (after Mathpal, 1985: fig. 1.1)

production, and long-distance exchange. Mehrgarh, for example, has large central storage buildings at this time, and evidence of specialized crafting zones for working hides and making wheel-made pottery, bone tools, and beads from the marine shell *Fascolaria trapezium* and from semi-precious stones (Jarrige, 1981). Signs of intensification in the agricultural system include an increasing reliance on cattle-herding, the use of a wider range of cereals than in the initial phase of settlement, and the beginnings of viticulture (on the evidence of fragments of vine wood as well as grape pips) and possibly the cultivation of cotton (*Gossypium*) as well (Costantini, 1984; Costantini and Costantini Biasini, 1985). Most of the cattle, sheep, and goats were now killed well before they matured, presumably for their meat.

Copper metallurgy was gradually incorporated into systems of production and regional exchange, and by the later fourth millennium there were proto-urban societies in the Indus valley and Baluchistan presaging the Harappan state (Dales, 1965, 1979, 1986; Shaffer and Thapar, 1992). The range of crops at pre-Harappan Balakot is much like that of the upper levels at Mehrgarh, and the killing ages of cattle, sheep, and goats were also similarly young (Meadow, 1986). Crude humped bull figurines at Balakot and Mundigak clearly represent zebu cattle. The range of crops suggests that the double-cropping system of traditional farming in north-west India had now begun, with winter (*rabi*) cereals and pulses and summer (*kharif*) crops like cotton and grapes (Fuller and Madella, 2001).

The spread of agriculture across the Indian sub-continent has traditionally been interpreted in terms of the spread of people, agricultural colonists (Fuller, 2002a). The thesis has been supported by the linguistic argument that the Dravidian languages must have developed from a people speaking proto-Dravidian. Most Dravidian-speaking peoples today are farmers or pastoralists, and Zvelebil (1973) argued that there were signs in their languages that they once must have been mountain or hill people. Such a thesis fitted neatly with the orthodox archaeological models of a Neolithic colonization (ultimately from South-West Asia across the Iranian plateau) from the uplands of Baluchistan into the Indus valley and thence into the Indian sub-continent (Fairservis, 1986). The Neolithic-proto-Dravidian colonization model has of course many parallels with the 'farmer-colonist' models that have been proposed to account for the development of Indo-European languages in Europe, Bantu languages in Africa, and Austronesian languages in South-East Asia (Bellwood, 2002, 2004; Diamond and Bellwood, 2003; Bellwood and Renfrew, 2002; and Chapter 3, pp. 99–102).

However, the increasing complexity of the archaeological record poorly fits such a model (Allchin, 1985; Fuller, 2002b). As forager societies came into contact with farmers, some incorporated aspects of the 'Neolithic package' into their lifeways, others resisted it. The evidence 'implies a prolonged

region-wide situation of inter-communication: not diffusion from a single major centre, for which there is no evidence whatsoever during the period considered; not parallel cultural evolution without mutual contact; but something more complex and fundamental than either of these somewhat oversimplified and over-worked concepts' (Allchin, 1985: 135).

On the eastern margins of the Indus valley, for example, sites such as Tilwara in the Thar desert have produced evidence for societies with 'Mesolithic' stone technologies which combined hunting and herding (Misra, 1989; Misra and Rajaguru, 1989). There is similar evidence from the Mahasati mound at Bagor near the Aravalli hills (Misra, 1973): along with a typical Mesolithic assemblage of geometric microliths and transverse arrowheads were small rubbing stones and querns, sherds of pottery, and a faunal assemblage dominated by bones of domestic sheep and goat (65 per cent), zebu (15 per cent), as well as a variety of small and medium-sized game and fish (Misra, 1973; P. K. Thomas, 1975). The site yielded evidence of windbreaks and huts with stone-paved floors, with communal food preparation areas in between, perhaps indicative of how these people were able to combine traditional foraging and new pastoralist social norms. The sheep and goats were mature, typical of the flocks of pastoralists today, in contrast with the high consumption of young meat at the Baluchistan farming villages. Another example of a mixed hunting-herding site is Adamgargh (Allchin, 1977). Burials have been found associated with these settlements, people being buried with clay pots containing meat, necklaces of stone and bone beads, and occasionally copper tools. One at Bagor had a clay spindle whorl at his or her feet (Misra, 1985).

The rich riverine resources of the central Ganga valley and its tributaries sustained increasingly numerous, and sedentary, societies living by hunting, fishing, and gathering (Chattopadhyaya, 1996; Pal, 1994; Sharma, 1973, 1985), much like the rich coastal environments of north-west Europe at this time (Chapter 9, pp. 342–3). A wide range of plant foods was exploited at Damdama, Mahagara, and Sarai-Nahar-Rai, for example, including many wild grasses and fruits such as *Chenopodium album*, wild rice, buckwheat, and jujube; the condition of the teeth of the people at Damdama, with heavy wear but a low incidence of caries, in fact confirms that the diet was dominated by coarse plant material. The diet was augmented by molluscs, birds, fish, and game, amongst which critical species were wild cattle, swamp deer, and hog deer (Fig. 5.7). Studies of the teeth of the deer indicate winter and summer occupations at the sites, and the range of foods in general is strongly suggestive that some locations may have been more or less permanent camps. In fact the body parts of the deer represented in the faunal samples indicate that the sites were base camps supplied by hunting parties using kill sites and hunting camps at a distance. The sites are also more substantial than before—there

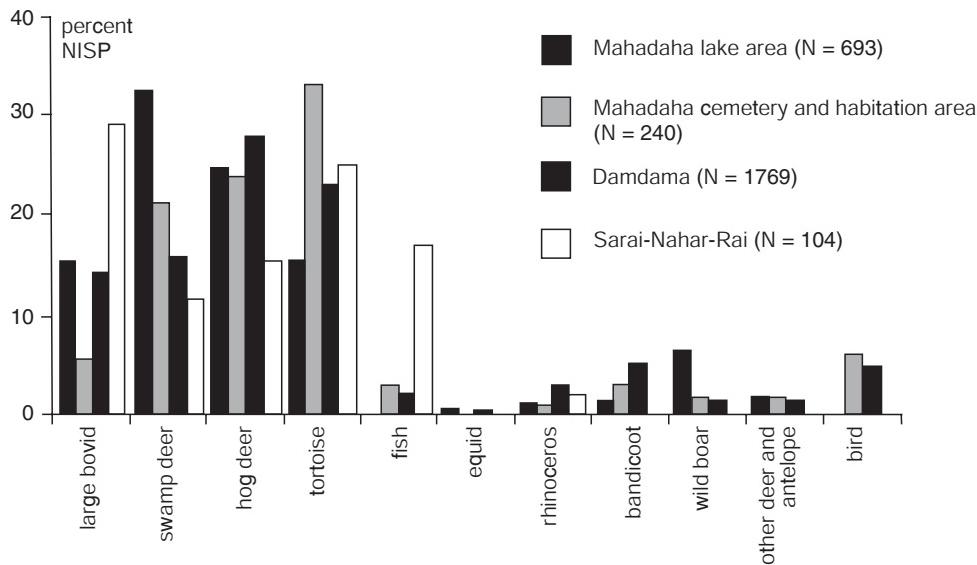
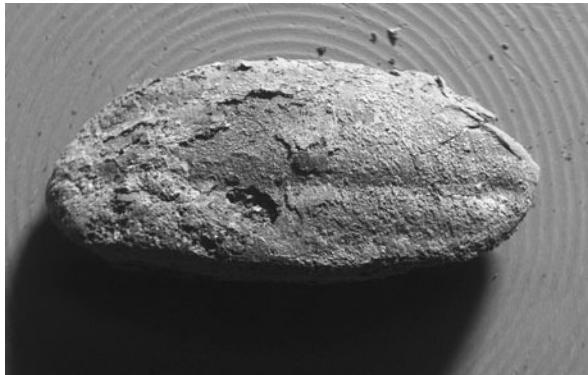


Fig. 5.7. Faunal remains from later Mesolithic sites in the central Ganga valley, based on percentages of identifiable bone fragments (the Number of Identified Specimens, or NISP); converting NISP to MNI (Minimum Number of Individuals) greatly reduces the number of tortoises, as the many individual fragments of one carapace are counted separately in the NISP procedure; the large bovid is almost certainly the gaur, *Bos namadicus* (after Chattopadhyaya, 1996: fig. 2)

were burnt plaster hut-floors, for example, and another indicator of increasing sedentism was the presence of the bandicoot rat *Bandicota bengalensis*, a commensal species.

It is also possible that these sedentary foragers were starting to practise small-scale horticulture and herding. Whilst wild rice is reported from Lekhahia (Kajale, 1994: 40), cord-impressed pottery with many impressions of rice stalks, glumes, and spikelets has been found at Chopani-Mando, Mahagara, and Koldihwa in the Belan valley, in deposits that may be as early as the seventh and sixth millennia BC (the chronology remains uncertain). Phytoliths from both leaves and husks imply that rice was being processed on site at Mahagara (E. Harvey, *pers. comm.*). The same sites have produced charred rice grains of variable morphologies that may reflect the presence of both domesticated and wild species (Fig. 5.8). Other crops identified include the small millets *Brachiaria ramosa*, *Panicum sumatrense*, and *Setaria verticillata*, lentil, pigeonpea, and grass pea. Bones of both wild and domestic cattle are also reported (Misra, 1977, 1985).

Fig. 5.8. Carbonized rice grain from Mahagara in the Belan Valley
(photograph kindly provided by Emma Harvey)



As in the sedentary forager societies of north-west Europe at this time, the Ganga settlements are associated with cemeteries. Males, females, and children are all represented in the burials, mostly orientated west–east. The dead were buried with objects such as bone earrings, necklaces, shells, and microliths, the variability in the grave-goods suggesting that differences in life according to age and gender were being marked out in death. The condition of their teeth—low caries, moderate calculus, moderate abscessing, moderate alveolar absorption, and high occlusal wear—is typical of other prehistoric forager societies, though like the sedentary later Mesolithic societies of Europe they also have high linear enamel hypoplasia, possibly indicative of periods of food scarcity (Lukacs and Pal, 1993). Flints embedded in the legs, hips, and arms of an adult male and two adult females at Sarai-Nahar-Rai suggest that these populous, sedentary communities may also have been characterized by inter-group warfare, another characteristic of the complex late Mesolithic foragers of north-west Europe. Occasional sherds of pottery and beads demonstrate that these societies were in some kind of contact with forager groups further west. This was presumably the source of any zebu cattle they herded.

MILLET AND RICE FARMING IN THE INDUS AND GANGA VALLEYS, *c.3000–1000 BC*

The Harappan state developed in the Indus valley during the course of the third millennium BC, and survived into the first few centuries of the second millennium BC. There were two major cities at either end of the valley, Mohenjo-daro and Harappa, other major centres such as Dholavira, Rakhigarhi, and Ganweriwala, and numerous smaller centres (Kenoyer, 1998). The cities were characterized by huge public buildings including bathing

complexes, and elaborately stratified societies of elites, priests, warriors, craft specialists, and agricultural workers (Dani and Thapar, 1992; Mariani, 1984; R. E. M. Wheeler, 1960). In addition to directly controlling production in their hinterlands, the Harappan cities were also in trading contact with the Mesopotamian states, particularly through the entrepot of Dilmun, modern Bahrain, in the Persian Gulf. The cuneiform records of Mesopotamia record trade through Dilmun with the regions of 'Magan' and 'Meluhha', the former probably Oman and the Iranian and Pakistani littorals, and the latter the cities of the Indus valley (Weisgerber, 1984). Though this trade was by sea, there is also evidence of long-distance overland trade, which had developed particularly during the fourth millennium BC between the Sumerians of Mesopotamia and the Iranian plateau and Turkmenistan in the context of the Sumerians' need for metal, precious stones, and perhaps timber. It is suspected that the Bactrian camel was domesticated in the context of these demands for overland transport across arid regions, though donkeys were also used (Caloi and Compagnoni, 1981; Compagnoni and Tosi, 1978; Shaffer, 1987).

The agricultural basis of the Harappan cities can be reconstructed from plant remains and animal bones from excavations, and there are also pictures on seals and seal impressions. A very wide range of crops preserved in the Harappan archaeological record demonstrates the effective integration of *rabi* and *kharif* systems in intensive systems of seasonal cropping, though the main food staples probably remained the winter cereals (Costantini, 1986; Fuller, 2001; Kajale, 1991; Meadow, 1989a; Weber, 1998; Table 5.2). The teeth of Harappans have a far higher incidence of dental disease such as caries, abscesses, and tooth loss than early populations, a phenomenon probably indicative of the increasingly dominant role of cereals in ordinary diet, along with improved food preparation methods (Lukacs and Minderman, 1992). The main domestic animal on the alluvial plain was the zebu (Fig. 5.9), with sheep and goats also important (Chitalwala and Thomas, 1978; Clason, 1977; Possehl, 1979; Rissman, 1989; P. K. Thomas, 1989). The water buffalo may also have been domesticated by this time for its traction power and milking qualities (it gives more milk, and higher quality milk, than the zebu). Remains from Santhli in coastal Rajasthan suggest that the process may have started in the late fourth millennium (Patel and Meadow, 1998), though some Indus seals show buffaloes attacking humans, so wild buffaloes were presumably still being hunted in the marshes. Camels and donkeys were probably also used; camel bones have been reported from Harappa and Mohenjo-daro, though the first reliable faunal evidence is after 2000 BC (Meadow, 1989a).

Some of the Harappan sites have also produced huge dumps of fish bones especially of the shallow-water *Pomadasys hasta*, molluscs such as the gas-tropod *Terebralia palustris* (an edible species living in mangrove swamps),

Table 5.2. Cultivated plants from Indus Valley sites of the third and second millennia BC

Plant taxon	Cropping season	Culture and date BC		
		4000–2600 (Pre-Harappan)	2550–2000 (Early Harappan)	2000–1700 (Late Harappan)
<i>Cereals</i>				
Barley (<i>Hordeum</i>)	W	R	R/K	R/K
Millets	S	K	R/K	R/K
Rice (<i>Oryza</i>)	S	—	K	R/K
Wheat (<i>Triticum</i>)	W	R	R	R/K
<i>Pulses and vegetables</i>				
Chickpea	W	—	R	R/K
Grams (various)	S	—	R/K	R/K
Grass pea	W	R	R/K	R/K
Hyacinth bean	S	—	K	R/K
Lentil	W	R	R/K	R/K
Pea	W	R	R/K	R/K
<i>Oilseed and fibre</i>				
Cotton (<i>Gossypium</i>)	S	R?	R	R/K
Linseed (<i>Linum</i>)	W	—	R/K	R/K
Mustard (<i>Brassica</i>)	W	—	R/K	R/K
Sesame (<i>Sesamum</i>)	S	—	R/K	R/K
<i>Fruits</i>				
Date (<i>Phoenix</i>)	S	R	R	R
Grape (<i>Vitis</i>)	S	R	R	R/K
Jujube (<i>Ziziphus</i>)	W	R/K	R/K	R/K
Melon (<i>Cucumis</i>)	S	—	K	R/K

Notes:

W = winter/spring harvested.

S = summer/autumn harvested.

R = rabi areas, with winter rain.

K = kharif areas, with summer rain.

Source: Weber, 1998: table 3.

and bones of game (Meadow, 1979, 1989a). The wild gaur (*Bos namadicus*) may have survived into Harappan times (Badam, 1984), though Grigson (1984) argued that images of unicorn-like cattle in Harappan iconography may reflect the fact that the gaur was, by this time, simply a memory. A quarter of one faunal dump at Harappa consisted of the bones of gazelle, deer, blackbuck, nilgai, and wild boar, and Meadow suggests that these collections may reflect the activities of specialist groups somewhat akin to later castes.



Fig. 5.9. Stamp seal from Mohenjo-daro of a Harappan zebu bull, c.2300 BC (British Museum registration no. 1947.4-16.1, photograph kindly provided by the Trustees of the British Museum)

Discoveries of millet in contexts such as at Tepe Gaz Tavila in south-east Iran in a sixth-millennium BC context (Costantini and Costantini Biasini, 1985) have stimulated theories that the African millets were introduced as a package to the Indus valley from Africa at this time in the context of the Dilmun trade, resulting in a revolutionary shift to summer cropping (Costantini, 1981; Possehl, 1986; Weber, 1992, 1998, 1999). Of the latter trade there is no doubt: the cuneiform records of Mesopotamia, for example, tell of large-scale trade with Meluhha in copper and other metals, semi-precious stones, furniture, exotic birds and animals, perhaps humans, and unspecified plants. However, there is no indisputable evidence for direct trade between South Asia and Africa at this time. Also, though sorghum has been found at Pirak near Mehrgahr dated to c.2000–1500 BC (Costantini, 1981), at Ahar in southern Rajasthan in what is probably a second-millennium BC context, and at Surkotada c.1600 BC (Vishnu-Mitre and Savithri, 1978), the evidence for the presence of the African millets in the Harappan heartlands is in fact weak, with cases of misidentification now acknowledged (Fuller, 2001). The theory of the African millets arriving in the Indus valley as a package also sits oddly with the fact that they were domesticated in widely separated regions of Africa, probably over a long timescale (Chapter 8). The current archaeobotanical evidence in fact suggests that the native small millets were gradually taken into cultivation over a considerable period of time, in the Harappan area as well as elsewhere in the peninsula, with the African millets being incorporated piecemeal into established systems of *kharif* cultivation (Fuller, 2001, 2003b; Fuller and Madella, 2001). There seems little doubt, though, that the

addition of millets and new pulses to the agricultural repertoire greatly increased the productive capacity of the Harappan economic system, for these highly productive summer crops could be combined with the wheats and barleys in intensive systems of multi-cropping on the Indus valley alluvium.

The role of rice cultivation within Harappan agriculture is less clear. Phytoliths and macrobotanical remains of domesticated rice have been reported from Harappa after c.2200 BC (Fujiwara *et al.*, 1992; Weber, 1997), and grains of domesticated rice have been found at Lothal and Rangpur dated to c.2000 BC, and at Ahar c.1800 BC (Glover, 1985). However, though domesticated rice was clearly known and available to Harappan farmers, at least from the later Harappan period, it does not seem to have been incorporated into Harappan agriculture on any scale, perhaps because it did not fit easily with existing systems of small-scale irrigation and seasonal labour scheduling (Fuller, 2001). In this context the prolific rice remains at Pirak (clay impressions of spikelets, stems, teguments, and seeds of domesticated rice) associated with impressive silos ideal for storing rice (Costantini, 1981) are very unusual, perhaps even an isolated and precocious case of the practice of wet-rice cultivation.

It has long been assumed from the distribution of modern wild species of rice that the primary area of domestication probably extended from southern China westwards as far as the central Ganga (T. T. Chang, 1976; Glover, 1985; Hutchinson, 1976; Watabe, 1984). DNA studies in fact indicate separate rice domestication histories in South Asia and China (D. J. Cohen, 1998: 23). Wild and cultivated rices today have the same chromosomes but morphological differences, which as in the case of the wheats and barleys primarily relate to seeding mechanisms. Wild rices shatter, have small hard-coated seeds so that they can survive dormancy in the ground, and cross-pollinate, whereas cultivated rices have large seeds with permeable coats, and self-pollinate (Vishnu-Mittre, 1985). Though fully domesticated rices have, for example, elaborate sculpturing on their husk surfaces that make identification easy, there is uncertainty over the reliability of criteria for distinguishing wild and domestic forms at the early stages of domestication. Presumably, in any case, there was much cross-pollination between wild and domestic plants in the early stages of domestication, until increasing diversification and the expansion of rice cultivation beyond the natural limits of the wild plant formalized the morphological characteristics of the cultivated plants.

Whilst the Mahagara and Koldihwa rice remains are unusually early, and are disputed (Glover and Higham, 1996: 416), the sedentary foragers of the Ganga valley described in the preceding section are the most likely people in South Asia to have embarked on rice horticulture given that wild rice was growing there and had probably been exploited for food from early in the Holocene on the evidence of the wild rice at Chopani-Mando dated to the eighth–seventh

millennia (Sharma *et al.*, 1980). However, the other dates for morphologically domesticated rice are consistently much later: in addition to the Harappan rice *c.*2200/1800 BC, for example, there is a date of *c.*1800 BC for rice at Chirand (Bihar) in the lower Ganga valley, and a series of dates from *c.*1500 BC and later from sites from the Indus valley to the central Deccan (Glover, 1985; Glover and Higham, 1996; Vishnu-Mitre and Savithri, 1978). Kajale (1994) reported a single sample of disintegrated rice from Adam in central India, from a context probably dating to *c.*2000 BC, but its condition made it impossible to determine its status as a morphologically wild or domestic form. Whatever the antiquity of rice farming in the Ganga valley, though, it is clear that by the second millennium BC rice was certainly being cultivated far from its natural range (Glover and Higham, 1996: 417).

TRANSITIONS TO FARMING IN THE INDIAN SUB-CONTINENT, *c.*3000–1000 BC

There is widespread evidence for an increasing commitment to pastoralism or mixed farming throughout South Asia contemporary with the Harappan state. To the north of the Indus, hunting and gathering increasingly gave way to the cultivation of *rabi* crops and stock-keeping during the third millennium BC at Bannu in Pakistan (Khan *et al.*, 1989; K. D. Thomas, 1981, 1983). The timescale seems to have been much the same in Kashmir, on the evidence of the Anchar lake pollen diagram and excavations of sites such as Burzahom (Agrawal *et al.*, 1989). The plant remains from Burzahom included bread wheat and barley, lentil, peach, walnut, and grape (Lone *et al.*, 1993). On the other side of the Indus in Swat, on the Pakistan–Afghan border, domesticated rice was being grown at Aligrama by the mid-second millennium BC, along with barley and lentils, and zebu and domesticated water buffalo were also kept (Compagnoni, 1979; Costantini, 1979). One of the most remarkable discoveries at Aligrama was a ploughed field buried under alluvium; dated to the eleventh century BC, we can almost see its water-buffalo and rice crop (Fig. 5.10).

The forager-herders living in Rajasthan on the eastern margins of the Indus valley were certainly in contact with the Harappans: at Bagor, for example, there are copper and bronze tools in the burials, a spindle whorl, and domestic cattle and sheep (Misra, 1989; P. K. Thomas, 1975). The high incidence of dental caries at Langhnaj indicates cereal consumption (Lukacs, 1985; Lukacs and Pal, 1993), though it is not clear whether these pastoralists were now also becoming cultivators as Allchin (1985) suggested, or simply trading pastoral products with neighbouring farmers. Further east in the central Ganga region,



Fig. 5.10. Aligrama, Swat (Pakistan): a ploughed field dating to the late second millennium BC, buried under alluvium, probably a rice paddy field (Glover and Higham, 1996: fig. 23.9; photograph kindly provided by Sebastiano Tusa)

there is similar evidence for the increasing importance of pastoralism. Sites consisting of clusters of circular hut floors such as Kunjhun II in the Son valley (J. D. Clark and Williams, 1986) and Mahagara in the Belan valley (Sharma *et al.*, 1980) have faunal samples increasingly dominated by domestic cattle, though wild cattle and bison are also reported as well as a variety of large- and medium-sized deer. At Mahagara there was a central cattle pen with their hoof impressions preserved in the clay, and there was a small fired-clay figurine of a zebu cow at Kunjhun II (J. D. Clark and Khanna, 1989). Rice-tempered pottery is also reported from the latter site.

The later third and second millennia BC witnessed a developing commitment to agriculture amongst the foraging communities of the more arid regions of the Deccan, based especially on the cultivation of millets and pulses and the herding of cattle, sheep, and goats (Dhavalikar, 1984, 1985; Dhavalikar and Possehl, 1974; Kajale, 1977; Korisettar *et al.*, 2001; Possehl, 1986). The increasingly rich archaeobotanical record from these Southern Neolithic sites suggests that indigenous millets such as browntop millet and bristley foxtail millet, and indigenous pulses such as mungbean and horsegram, were gradually taken into *kharif* cultivation in a piecemeal fashion, in a process independent of Harappan agriculture (Fuller, 2003a; Fuller *et al.*, 2001, 2004;

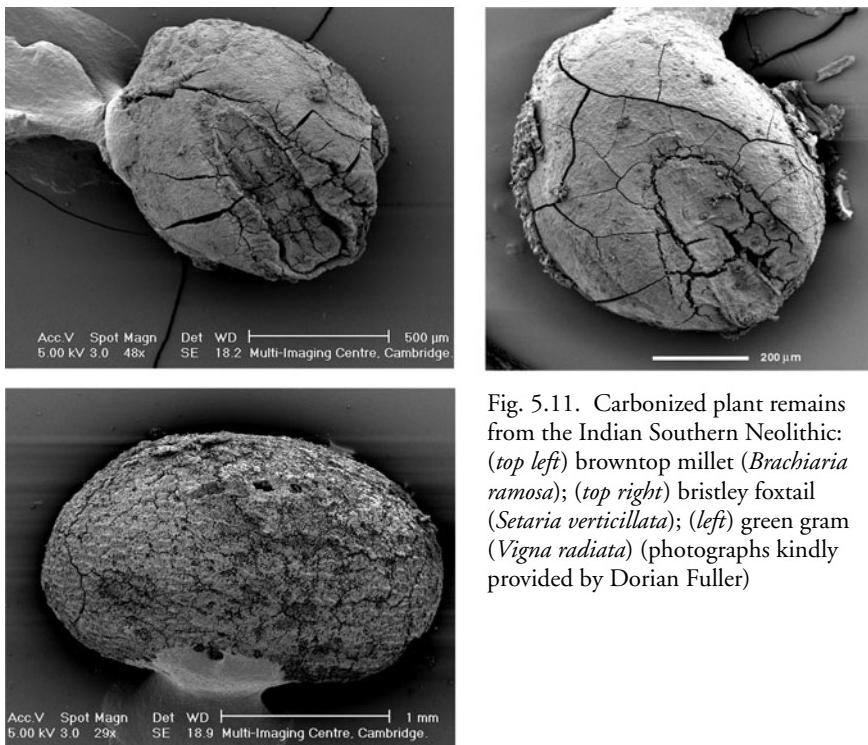


Fig. 5.11. Carbonized plant remains from the Indian Southern Neolithic: (top left) browntop millet (*Brachiaria ramosa*); (top right) bristley foxtail (*Setaria verticillata*); (left) green gram (*Vigna radiata*) (photographs kindly provided by Dorian Fuller)

Fig. 5.11). Millet was certainly better suited to most regions here than the winter cereals because of the summer monsoon, and millet stalks also made prime fodder for zebu (Meadow, 1989a), though the Harappan winter cereals and pulses were eventually adopted by these communities more or less as a single package.

Significantly, this was amidst signs of increasing complexity in social and economic structures. In the central Deccan, for example, a hierarchy can be discerned of smaller and larger settlements, examples of the second being Inamgaon and Daimabad. There are indicators of social hierarchy within the latter settlements: rather substantial rectangular dwellings contrast with smaller structures, houses are in distinct clusters, and the larger houses are equipped with storage silos. Technological innovations included wheel-made painted pottery and copper metallurgy. A pot from Inamgaon has an engraving of a cart drawn by bullocks (P. K. Thomas, 1989: 109). The construction of a flood diversionary channel at Inamgoan, 4 metres wide and 3.5 metres deep, with a stone embankment 2 metres wide beside it, surviving for over a hundred metres, may be a sign of attempts to deal with increasing aridity in the

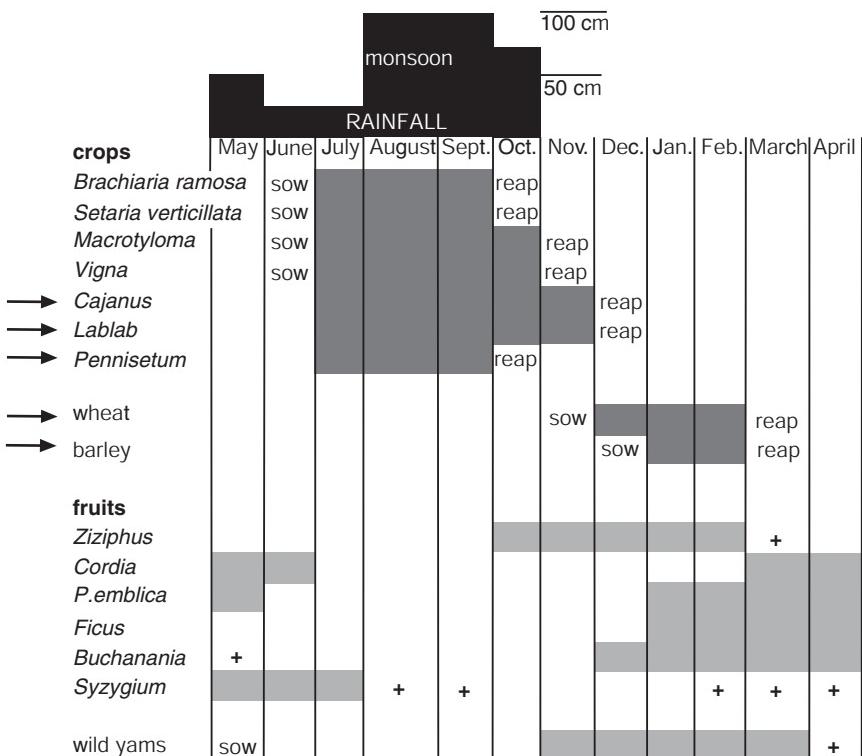


Fig. 5.12. Inferred seasonality of Southern Neolithic cultivation and foraging, based on predominant modern seasonality; crosses mark possible extensions to fruiting seasons; arrows mark non-indigenous (introduced) crops (after Fuller *et al.*, 2001)

second millennium BC (Dhavalikar, 1989), but is certainly striking evidence of the scale of the commitment to crop husbandry at these sites. The agricultural villages also appear to have been associated with hinterlands of pastoral transhumance that are represented by clusters of 'ashmound' sites, low mounds composed of ash and vitrified cattle dung such as Utnur (Allchin, 1963). The adoption of wheat and barley cultivation by the Deccan villages added a new cropping season to their agricultural calendar (Fig. 5.12), but given their lack of suitability to the monsoonal climate, the new crops may have been valued more as prestige commodities than as staple crops for buffering risks or increasing food supply (Fuller *et al.*, 2001). The new pottery styles, for example, may be evidence of changing culinary norms, though the condition of the teeth of the Inamgaon population indicates little significant change in what remained a mixed coarse diet (Lukacs, 1985).

CONCLUSION

The evidence for the beginnings of farming in Central and South Asia is lacking in precision compared with other parts of the world. There are very limited data on the course of landscape change between, say, 15,000 and 5,000 years ago, and in most parts of this vast region we have little understanding of how people were living in the closing millennia of the Pleistocene and the opening millennia of the Holocene. Discussion of agricultural transitions throughout this vast region is hampered by poorly dated sites, and problematical identifications of wild and domestic cattle, sheep, goats, and plants.

Despite (or because of?) the weaknesses in the data, there has been a consensus about how and why farming began here: farming knowledge, the domesticates, and probably farmers, spread eastwards from South-West Asia and westwards from China. Liversage, for example, concluded that 'there is no evidence of a totally autochthonous development of food production' (1989: 292). Similarly in *The Living Fields*, Harlan assigned just one paragraph to the Indian evidence, summarizing it (1995: 169) as: 'a wheat, barley, lentil, chick-pea, lathyrus, flax etc. culture arrived from the west... rice, fruits and roots arrived from the east'. Bellwood and Barnes (1993) came to a similar conclusion, in their case linking the spread of agriculture with agricultural colonists speaking new languages: Indo-European-speakers moved eastwards into the Indus and Ganga valleys from homelands in western and central Asia, and Dravidian-speakers spread southwards through the Deccan. Sites where farming and foraging were combined were taken as evidence of the incomers intermarrying with indigenous foragers. My own reading of the evidence is clearly rather different.

The development of 'Eurasian' systems of farming may—possibly—be later in Turkmenistan and Baluchistan than in South-West Asia. Sites like Jeitun and Mehrgarh at the junction between uplands and alluvial steppe are broadly contemporary with PPNB sites in South-West Asia. PPNB sites in South-West Asia, though, were part of a long process of subsistence change that was primarily focused in the uplands, but equivalent upland regions in Central Asia such as Afghanistan are very poorly researched. What is also particularly striking about early farming in Turkmenistan and Baluchistan is that it was distinctive and different from contemporary PPNB farming systems in South-West Asia, not simply an extension of it. Also, the modern distributions of wild species of cereals, sheep, and goats can only be taken as a general guide to their distributions at the beginning of the Holocene (to say nothing of where they were in the closing millennia of the Pleistocene). To my mind, therefore, there is a strong possibility that there was a series of parallel early domestication stories variously affecting components of what was to become

the Eurasian system of agriculture and located variously between the Levant (and perhaps the eastern Mediterranean: see Chapter 9) in the west and the Hindu Kush and Baluchistan uplands in the east.

Liversage (1989) argued that farming and pastoralism only developed in the Indian sub-continent after the Neolithic farmers of Baluchistan and the Indus valley were able to 'breach the barrier' formed by the Thar desert, allowing the development of rice farming in the Ganga valley and cattle pastoralism in the Deccan. However, it is clear that the inhabitants of the Ganga valley were in fact harvesting wild rice from (at least) very early in the Holocene. Rice horticulture may well have been a component of the subsistence systems that sustained the populous, sedentary, and socially complex forager societies who were living in the Ganga valley at a period contemporary with Jeitun and Merhgarh. Again, as Singh (2002) also argues, the evidence suggests an independent trajectory of subsistence intensification in the Ganga valley rather than a Neolithic colonization process westwards from East Asia, one outcome of which was the cultivation of morphologically domestic rice.

Presumably rice reached the Indus valley during the later third millennium BC as part of exchange systems between the Harappans and the Ganga valley. Whether the Harappans acquired the African millets through trade with the Persian Gulf, Mesopotamia, and the Horn of Africa is uncertain, though they were certainly well acquainted already with the indigenous millets. The integration of *rabi* and *kharif* husbandry regimes greatly increased the productive potential of Harappan farming, sustaining dense urban and rural populations in the Indus valley.

Foragers in the arid eastern margins of the Indus valley and the Deccan had been augmenting foraging with the herding of cattle, sheep, and goats for perhaps a thousand years before the Harappan state, and had probably started to domesticate indigenous millets and pulses as well in a long-lived and piecemeal fashion, before they acquired new resources such as the African millets and wheat and barley. The spread of wheat and barley from the Harappan heartlands appears to have been very rapid, the first example of an important trend we shall observe in South-East Asia, North America, Africa, and Europe: the dispersal of domesticates to regions where they were not part of the local ecology (commonly interpreted in terms of migrating farmers shifting an 'agricultural frontier' forwards) was generally characterized not by gradual expansion but by standstills and spurts, the latter often of remarkable rapidity over huge distances. In the Indian sub-continent this phenomenon of 'punctuated explosive dispersal', together with the many continuities in the archaeological record, suggests to me complex processes of acculturation, of domesticates being adopted by the local forager population who committed to farming to different degrees, at different rates, and with

differing repercussions. The second feature of the dispersal process of new agricultural resources into the peninsula we shall also find chiming with the spread of many domesticates in other regions of the world: that in the critical phases of their incorporation into existing systems of subsistence they often did not have a primary value as key dietary staples. That status was to come later, in the context of significant transformations in technologies and labour organization. It was probably not till the first millennium BC, for example, that farming characterized most of the Indian sub-continent, its rapid spread into most areas and onto most soils at that time facilitated above all by the accessibility of iron tools.

We do not understand how and why foragers in Central Asia began to cultivate wheat and barley and herd sheep and goats. Or why foragers in the Ganga valley moved from gathering rice to farming it. Or why the foragers of the sub-continent began to commit to elements of farming in the third and second millennia BC. These questions have simply not been posed by most archaeologists working in the region. But whilst there is much that we do not understand, it is no longer tenable to regard the transition to farming in Central and South Asia simply as some kind of aftershock of cultural earthquakes in South-West Asia and China, with Indo-European and Dravidian farmers colonizing the region in search of new land and marriage partners. Significantly, modern linguistic studies suggest that the earliest stages of the Dravidian languages were in fact associated with people who were foragers rather than agriculturalists (Fuller, 2002b, 2003b; Parpola, 1994).

6

Rice and Forest Farming in East and South-East Asia

INTRODUCTION

East and South-East Asia is a vast and diverse region (Fig. 6.1). The northern boundary can be taken as approximately 45 degrees latitude, from the Gobi desert on the west across Manchuria to the northern shores of Hokkaido, the main island of northern Japan. The southern boundary is over 6,000 kilometres away: the chain of islands from Java to New Guinea, approximately 10 degrees south of the Equator. From west to east across South-East Asia, from the western tip of Sumatra at 95 degrees longitude to the eastern end of New Guinea at 150 degrees longitude, is also some 6,000 kilometres. Transitions to farming within this huge area are discussed in this chapter in the context of four major sub-regions: China; the Korean peninsula and Japan; mainland South-East Asia (Vietnam, Laos, Cambodia, Thailand, the Malay peninsula); and island South-East Asia (principally Taiwan, the Philippines, Sumatra, Java, Borneo, Sulawesi, and New Guinea). The chapter also discusses the development of agricultural systems across the Pacific islands to the east, both in island Melanesia (the Bismarck Archipelago and the Solomon Islands east of New Guinea) and in what Pacific archaeologists are terming ‘Remote Oceania’, the islands dotted across the central Pacific as far as Hawaii 6,000 kilometres east of Taiwan and Easter Island some 9,000 kilometres east of New Guinea—a region as big as East Asia and South-East Asia put together.

The phytogeographic zones of China reflect the gradual transition from boreal to temperate to tropical conditions, as temperatures and rainfall increase moving southwards (Shi *et al.*, 1993; Fig. 6.2 upper map): coniferous forest in the far north; mixed coniferous and deciduous forest in north-east China (Manchuria) extending into Korea; temperate deciduous and broad-leaved forest in the middle and lower valley of the Huanghe (or Yellow) River and the Huai River to the south; sub-tropical evergreen broad-leaved forest in the middle and lower valley of the Yangzi (Yangtze) River; and tropical

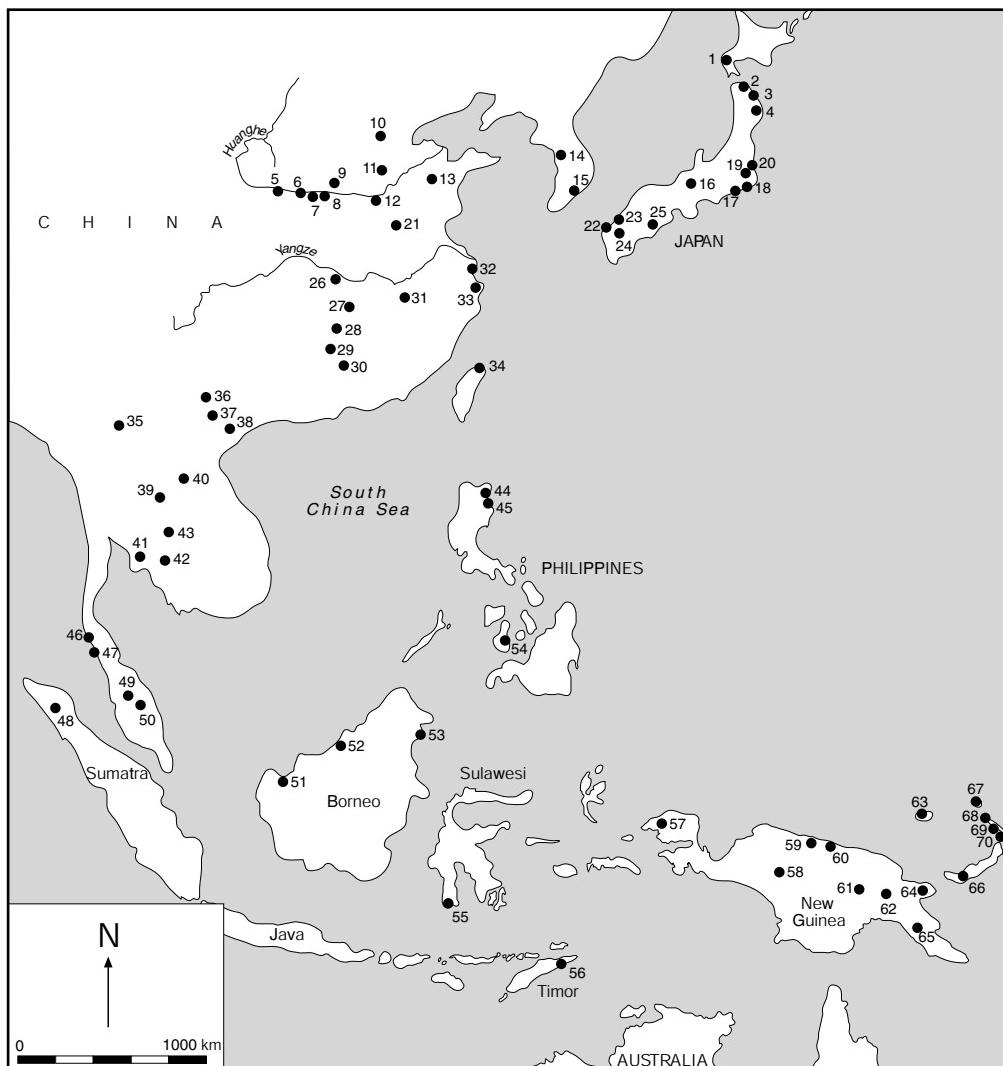
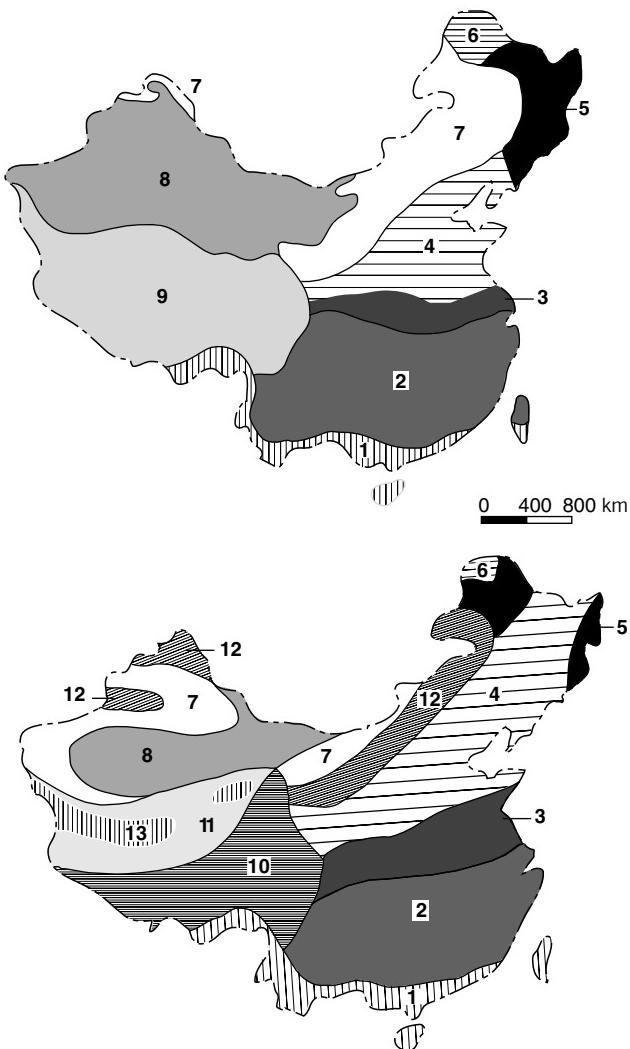


Fig. 6.1. East and South-East Asia, showing the principal sites and regions mentioned in Chapter 6.

Sites: 1. Usijiri; Yagi; 2. Sannai Maruyama; 3. Kazahari; 4. Nishida; 5. Beishouling; 6. Banbo; 7. Jiangzhai; 8. Yang-shaocun or Yangshao; 9. Hsi-yin-ts'un; 10. Nanzhuangtou and Hutouliang; 11. Anyang; 12. Peiligang; 13. Dawenkou; 14. Juyupri and Kawaji, Ilsan City; 15. Tongsamdong; 16. Torihama; 17. Shimotakabora; 18. Otsubo; 19. Soya; 20. Kamitakatsu; 21. Jiahu; 22. Fukui Cave; 23. Itatsuke; 24. Ikiriki; 25. Kamikuroiwa; 26. Bashidang, Pengtoushan; 27. Hutouliang; 28. Yuchanyan; 29. Zengpiyan Cave; 30. Shih-hsia (Shixia); 31. Xianrendong Cave, Diaotonghuan or Wangdong Cave; 32. Majabang; 33. Hemudu, Shang-shan; 34. Dapenkeng, Kending; 35. Spirit Cave; 36. Son Vi; 37. Xom Trai; 38. Hoa Binh; 39. Non Nok Tha; 40. Ban Chiang; 41. Khok Phanom Di; 42. Laang Spean; 43. Ban Non Wat; 44. Andarayan; 45. Dimolit; 46. Lang Rongrien, Moh Khiew; 47. Trang; 48. Northern Sumatra pollen sites (Pea Bullock etc.); 49. Gua Gunung Runtuh; 50. Gua Cha; 51. Gua Sireh; 52. Niah Cave; 53. Madai; 54. Tanjay; 55. Leang Burung; 56. Lene Hara cave; 57. Bird's Head peninsula; 58. Baliem valley; 59. Lake Hordorli; 60. Lachitu Cave; 61. Kuk; 62. Nomebe; 63. Pawmaw; 64. Huon peninsula; 65. Kosipe; 66. Yombon; 67. Mussau island; 68. Panakiwuk; 69. Balof; 70. Matenbek, Matenkupkum.

Fig. 6.2. Vegetation types in China (above) today and (below) during the Holocene climatic optimum: 1. tropical monsoon rainforest; 2. evergreen broad-leaved forest; 3. deciduous and evergreen broad-leaved mixed forest; 4. deciduous broad-leaved forest; 5. coniferous and deciduous broad-leaved mixed forest; 6. coniferous forest; 7. steppe; 8. desert; 9. highland vegetation; 10. highland forest steppe; 11. highland steppe; 12. forest steppe; 13. highland desert (after Shi *et al.*, 1993: figs. 6 and 7)



monsoonal rainforest on the southern coasts, which then extends southwards across mainland and island South-East Asia. Climate and vegetation also differ with altitude and distance from the coast. In mainland South-East Asia, for example, the coasts are dominated by mangrove forests, the lowlands (up to about 400 metres above sea level) by sub-tropical moist forest. Above is sub-tropical wet forest up to about 1,000 metres, and there is sub-tropical lower-montane wet forest and rainforest above (Higham, 1989a). Mangrove swamps and lowland wetlands suit animals such as rhinoceros,

water buffalo, and swamp deer. The lower sub-tropical vegetation, adapted to sharp seasonality in moisture, lacks a permanent tree canopy and so favours the growth of shrubs and grasses favourable to grazing animals such as deer, cattle, and elephant, and is also easily modified by dry-season burning. The denser canopy of the sub-tropical wet forest allows little grass growth and is best suited to animals such as the pig, but clearings can provide food for elephant, rhinoceros, cattle, and deer. Tropical rainforest is particularly stable, the dense canopy screening the ground from the direct impact of sun and rain.

The monsoonal regions of China and South-East Asia are characterized by a winter dry season when dry air flows westwards from eastern Asia, and a summer wet season when humid moist air flows from the south-west. These conditions are particularly favourable for the summer cereals, the millets and rice. The two main millets grown today are foxtail millet (*Setaria italica*) and common or broomcorn millet (*Panicum miliaceum*), both tolerant of drought and poor alkaline soils. Rice (*Oryza sativa*, mainly *japonica* or *sinica* in East Asia and *javanica* in South-East Asia) is most commonly grown in 'wet' systems in lowland regions, either in bunded (enclosed) fields fed by monsoon rains or more elaborately in irrigated hill-slope terraces. It can also be grown 'dry' in upland swidden or 'slash-and-burn' systems using temporary forest clearings. The critical animal for wet-rice farmers today is the water buffalo, though as far as we can tell at present, neither water buffalo nor the plough were part of wet-rice farming in prehistory. In much of tropical South-East Asia and in Melanesia and Remote Oceania, agriculture has traditionally been based primarily on root and tuber crops, notably taro (*Colocasia esculenta*), yams (such as *Dioscorea alata* and *Dioscorea esculenta*), and sweet potato (*Ipomoea batatas*). Other important crops are sugarcane (*Saccharum robustum* or *officinarum*) and treecrops such as sago (*Metroxylon*), banana (*Musa*), and coconut (*Cocos nucifera*). Legumes are also grown, and another important crop is *Areca catechu*, the betel nut palm. The main livestock kept by farmers growing these crops consists of pigs, dogs, and chickens.

The wild progenitor of foxtail millet is assumed to be green brittlegrass (*Setaria viridis*), a common diploid weed that grows commonly throughout Eurasia (Zohary and Hopf, 1988). Broomcorn millet also grows as a weedy naturalized or feral plant across central and eastern Eurasia. Wild rice is found today throughout mainland and island South-East Asia and in China as far north as the Yangzi, in both perennial and annual forms. There has been much debate about the possible relations between modern wild, domesticated, and weedy rice, starting from T. T. Chang's seminal paper in 1976, with one common theory being that upland *japonica* developed from the

lowland *indica* of South Asia (T. T. Chang, 1989). DNA studies now indicate that *japonica* evolved in China from *Oryza rufipogon*, the wild perennial, and that *Oriza indica* evolved separately from *Oryza nivara*, the annual wild form (M. K. Jones and Brown, 2000), favouring the thesis of separate domestication events in India and China as discussed in the previous chapter (Cohen, 1998: 23).

Much of our understanding of the history of rice domestication depends on archaeobotanists' interpretation of whether rice residues recovered from archaeological sites belong to wild or domestic strains. Grain size is one criterion used because modern wild rice has small grains and modern domestic varieties have large grains. At many key sites in China, though, the only evidence surviving consists of microscopic silica phytoliths. In modern wild rice the phytoliths produced in the cells of the glumes, the husks that protect the grains, are consistently smaller than those in the glumes of domestic rice (Pearsall *et al.*, 1995). There is some debate, though, about the reliability of distinguishing domestic from wild rice in the early stages of husbandry using comparisons of the size differences between modern wild and domestic rice. Also, as in the case of wheat and barley in South-West Asia (and South Asia?), some forms of plant tending and management could have been practised for a long time without leading to the development of morphologically differentiated wild and domestic rice plants. Hence botanical criteria cannot be used in isolation in the study of transitions from rice foraging to rice farming.

The distribution of wild yams and taro before their domestication is also much debated, but whereas it used to be thought that they would have been restricted to mainland South-East Asia, the archaeological record shows that they were widely distributed also in Island South-East Asia and possibly Island Melanesia as well (Yen, 1990, 1995) and, as we shall see, were exploited by Pleistocene foragers there.

Water buffalo is domesticated from its wild progenitor *Bubalus bubalis*, DNA studies indicating two independent domestications, probably one in South Asia and the other in East Asia (D. Bradley, 2000; Fig. 3.11). The main species of wild cattle today are the gaur (*Bos gaurus*) in mainland South-East Asia, and the banteng (*Bos javanicus*) found in Burma, Thailand, Cambodia, Vietnam, Java, and Borneo. Their domestic forms are respectively the mithan (*Bos frontalis*) and the bali (*Bos javanicus domesticus*) (Groves, 1985). There are three main species of wild pig today, sub-species of *Sus scrofa* (the wild boar found throughout Eurasia from the Atlantic to the Pacific): *Sus scrofa vittatus* in mainland South-East Asia, and the warty pig *Sus verrucosus* and bearded pig *Sus barbatus* in island South-East Asia. Most domestic pigs in the region are *Sus scrofa*, but *Sus papuensis*, a New Guinea domestic pig, is assumed to have been domesticated from *Sus verrucosus*.

LATE PLEISTOCENE FORAGERS (AND PLANT TENDERS?) IN EAST ASIA

With the cooling of the world's climate and changes to weather systems in the late Pleistocene, summer monsoonal circulation was greatly weakened and winter monsoonal circulation strengthened, bringing cold and dry conditions to East Asia. Steppe vegetation such as chenopods, grasses, and *Artemisia* expanded across northern and central China, and mixed pine and broad-leaved deciduous forests contracted to south of the Yangzi (Feng *et al.*, 1993; Higham and Lu, 1998; Maloney, 1992, 1998; Sun and Chen, 1991). These landscapes were widely populated by Pleistocene foragers. There is growing evidence that the climatic amelioration after the Last Glacial Maximum was the context for dramatic changes in subsistence behaviours amongst the foraging populations of East Asia that bear many similarities to the transformations in Natufian life at this time in the Near East.

Nanzhuangtou in northern China is an open-air site with palaeoenvironmental indicators of a warm and moist climate inclining towards dry and cool conditions, probably the Late Glacial amelioration—the radiocarbon dates indicate a calibrated age of about 12,000 bc. It has sherds of plain pottery, grinders, bones of game and what is probably domestic dog, and pollen of beans and green bristlegrass, the assumed ancestor of millet (Underhill, 1997). The occurrence of domestic dog at the site chimes with the inferences from a recent genetic study that dogs were domesticated in East Asia about 15,000 cal. bp (Savolainen *et al.*, 2002). Domestic pig was also claimed for Nanzhuangtou, but it now seems clear that the bones were of morphologically wild specimens (Yuan Jing and Flad, 2002). The basal levels of the Xianrendong and Diaotonghuan—also known as Wangdong—caves south of the Yangzi, which also probably date to the Late Glacial (the radiocarbon dates are not universally accepted), contain phytoliths of wild rice (identified as wild on the size criteria mentioned earlier) associated with small grinding stones. Wild rice consumption has also been inferred from isotope studies of the human skeletal material (MacNeish and Libby, 1995; Zhao, 1998). Yuchanyan or Hamadong cave in the same region of southern China has produced some 40 species of plants including a few husks of wild rice in a deposit probably dating to a colder episode that may equate with the Younger Dryas in Europe, together with other food refuse including a wide variety of animals, birds, fishes, turtles, and shellfish (D. J. Cohen, 1998). The same levels also contained sherds of a coarse, soft, low-fired pottery tempered with quartz, pottery produced by moulding clay over earth mounds covered with matting, and then beaten with a wooden paddle wrapped in cord to create cord markings.

The deer antlers at Xianrendong indicate occupation of the site in autumn, winter, and spring, suggesting the development of increasing sedentism, which the production of pottery also implies. The period for harvesting wild rice is extremely short, and people exploiting it needed to be at the right place at the right time, and then to have the technology to store the harvest for later consumption. Green bristlegrass also has a very short interval between ripening and shattering. The importance of wild rice and millet in the diet at this time is hard to judge. The small size of the seeds means that returns would have been low: 1,000 dry grains of green bristlegrass harvested experimentally weighed less than three grams, for example (Lu, 1998). However, Sage (1995) argues that rising CO₂ levels in the Late Glacial, from below 200 to about 270 parts per million, would have made plants such as wild rice 25–50 per cent more productive than today. Certainly the parallel appearance at this time of pottery and millet in northern China, and of pottery and rice in southern China, suggests that the foragers of both regions were finding it worthwhile to manufacture simple ceramic vessels to assist with the storage, processing, and cooking of plant foods. In Japan (which was connected to mainland China at the Last Glacial Maximum), pottery was also being produced by terminal Pleistocene populations, for example at sites such as Fukui Cave and Kamikuroiwa rock shelter, but no plant remains have yet been recovered of this antiquity (Imamura, 1996).

Most Late Glacial sites in mainland South-East Asia have produced industries of flakes or pebbles with all-over flaking. They represent the beginnings of the Hoabinhian tradition that was to endure in many places for thousands of years into the Holocene, probably because it was used for making a rich technology of wood and bamboo that has not survived (Bellwood, 1997; Glover and Presland, 1985; Rabett, 2005). Caves in western Thailand were visited in the wet season by a people who hunted deer, turtles, and a variety of small mammals, collected molluscs, and probably gathered forest tubers and edible shoots (Shoocongdej, 2000). Lowland Vietnam, though, was probably a refugium for wild rice in the Last Glacial Maximum; charred rice of a size similar to modern domestic rice has in fact been found in a terminal Pleistocene context at Xom Trai, along with ground-edge tools, but the deposit may be disturbed (Glover and Higham, 1996: 421).

The nature of climatic change in the terminal Pleistocene is less clear than in other parts of the world. For example, there is widespread evidence for a colder oscillation contemporary with, and possibly equated with, the Younger Dryas interstadial further west, but this was not observed in the Trang pollen diagram in southern Thailand (Maloney, 1998). The beginning of the Holocene c.9500 BC marked a return to warmer and wetter climates.

EARLY HOLOCENE FARMING IN EAST ASIA

The first Chinese civilization developed in the basin of the Huanghe in the middle of the second millennium BC. Excavations at Anyang, beginning at the end of the nineteenth century, demonstrated that the site was the administrative and ceremonial centre of the historically documented Shang state. Much understanding of Shang culture, society, and economy, including the fact that the agricultural basis of the state was wet-rice farming, was derived from epigraphic studies of large numbers of inscribed 'oracle bones' from the site (K.-C. Chang, 1986; Keightley, 1983). For example, there are frequent references on the oracle bones to *shu* and *ji*, almost certainly millets, and to *dao*, probably rice, and to all aspects of silk weaving from mulberry trees to the silkworm *Bombyx mori* (C. Higham, *pers. comm.*). Further research in the 1920s and early 1930s, before archaeological fieldwork came to a halt with the Sino-Japanese war, established the nature of preceding prehistoric societies in northern China. Chinese Neolithic studies effectively began in 1921 with the investigation of the settlement of Yang-shaocun in the Huanghe valley by the Swedish geologist J. Gunnar Andersson. His excavations found traces of substantial dwellings associated with polished stone tools, elaborate finely made painted pottery, and bones of domestic animals such as dog, chicken, and pig (Andersson, 1934). Discoveries at comparable sites in ensuing years indicated that the primary crops for these Yang-shao farmers were the millets. In the early 1930s, evidence was found of a later stone-using or Neolithic culture in the same region, characterized by finely burnished black pottery, termed Longshan. The first radiocarbon dates placed the Yang-shao culture in the middle of the fourth millennium BC, and until the late 1960s, the prehistory of Chinese agriculture was described in terms of the Yang-shao and Longshan Neolithic cultures, each thought to span perhaps a thousand years, respectively c.3500–2500 BC and c.2500–1500 BC (W. Watson, 1969a, 1969b). In his 1976 review of the origins of rice farming, Chang noted that the first evidence for rice in China was at Longshan sites. He argued that Longshan farmers were growing the crop in marshy soils, and that the beginnings of rain-fed rice farming were not until the period of the Shang state, when domestic water buffalo were known to have been used. Research over the past thirty years, however, has revolutionized understanding of transitions to farming in China, indicating that both millet and rice farming go back to the very beginnings of the Holocene if not, as we saw earlier, into the late Pleistocene, beginning in the foothills and then expanding into the valley bottoms much as in the case of wheat and barley farming in South-West Asia.

The evidence of pollen diagrams, palaeosols, and lake sediments combines to show that the early and mid-Holocene in China was characterized by warmer and wetter climates than today, with humid strong summer monsoons and weaker winter monsoons (Feng *et al.*, 1993; Higham and Lu, 1998; Shi *et al.*, 1993; Sun and Chen, 1991). The trend probably reached a peak c.7000 BC and lasted for over a millennium before cooler conditions developed. It is estimated that average winter temperatures rose by two degrees in the Yangzi valley and three or four degrees in the Huanghe valley. Sea levels, which had been rising since the Last Glacial Maximum, were several metres higher than present coastlines at this time, and lake levels also rose (Fang, 1991). The climatic warming allowed phytogeographic zones to shift northwards, the tropical and evergreen broad-leaved forests of the south by about a degree of latitude, the deciduous and evergreen broad-leaved forests by three degrees, and the temperate deciduous and broad-leaved forests of northern China by as much as four degrees (Fig. 6.2 lower map). Mangrove swamps spread northwards up the coasts, and southern Chinese fauna such as water deer, elaphure, and bamboo rat were also able to spread northwards (Crawford, 1992b). Another result of the ecological shifts was that wild rice spread northwards into the Yangzi basin, though the temperature cooling that developed from about the later sixth millennium BC (the exact chronology is unclear) would have depressed the northern margins of its range once more.

Intriguing evidence for the nature of early Holocene subsistence in the subtropical evergreen broad-leaved forests of southern China has been found in the cave of Zengpiyan, occupied at the beginning of the Holocene. Grinding stones indicate plant processing, and pollen analysis suggests the use of a variety of starchy plants and fruits (Underhill, 1997: 135). The same levels contained numerous bones of pig, mostly killed very young. Although selective hunting might produce such a mortality profile, the canine teeth exhibit marked size reduction that may be indicative of selective culling and herd management. One point often made about tropical farming is that the main threat to the root and tuber crops of forest swidden fields is the pig, which has to be either controlled or eliminated from the locality. Whilst the evidence for pig management at Zengpiyan is ambiguous—and if confirmed it would be the earliest in the world—this is certainly the part of China where we might first expect to find people trying to exert control over pigs liable to damage their crops.

Further north, but still south of the Yangzi plain, the caves of Xianrendong and Diaotonghuan produced phytoliths identified as of wild rice from their earliest Holocene layers, like those of the Late Glacial, but there were also now sickle-like implements made from mollusc shells, as well as the first sherds of pottery (MacNeish and Libby, 1995). Similar phytoliths of wild rice

predominate in the succeeding phase of occupation distinguished by the excavators, perhaps dating to the ninth millennium BC, but pollen and phytoliths also suggest the possible presence of morphologically domesticated rice. Without rachis fragments it is difficult for the archaeobotanists to make definite statements about morphological status, but statistical studies (multivariate discriminant analysis) of rice grains from this period at Diaotonghuan suggested the presence of three rice populations, which were taken to be wild, domestic, and intermediate in form (Zhao, 1998). The same levels also produced stone adzes and hoes, and perforated stone weights for digging sticks, so taking all the evidence together some kind of tillage (ground preparation) and plant-tending looks likely. By c.7500 BC, phytoliths of domestic rice predominate over those of wild rice in the sediments, and the technology included the full range of digging, harvesting, and seed-processing equipment, so it seems certain that horticulture was being practised by this time. No evidence, however, has been found to suggest that these cultivators were also herding pigs—their meat protein seems to have come mainly from turtles, shellfish, crabs, and fish. Over the same period potting technology also improved rapidly: at first pots were made of slabs and decorated with cord; later they were made by coiling and paddling, and decorated with wrapped fibres.

By the middle or latter part of the eighth millennium BC, rice was certainly being cultivated further north, throughout the middle Yangzi valley and possibly (on the evidence of rice temper in pottery at the site of Shang-shan) in the lower Yangzi valley as well. At that time this region was a landscape of shallow lakes and marshes that provided extensive natural habitats for wild rice, together with adjacent lowlands suitable for conversion to paddy fields. Sites such as Pengtoushan and Bashidang were quite substantial settlements extending over a hectare or more, Bashidang being enclosed by an earthen wall and ditch (Ahn, 1990; D. J. Cohen, 1998; Crawford and Shen, 1998; Higham and Lu, 1998; Normille, 1997; Zhimin, 1991). There were well-constructed rectangular houses, storage pits, and carefully divided burial areas. A wide range of pottery was produced, mostly associated with food storage and preparation, including round-bottomed vessels with cord decoration and tripod cooking supports. The temper for the clay has yielded numerous samples of rice grains and chaff. Some 15,000 grains of rice were also found in organic-rich layers at Bashidang (Pei, 1998; Fig. 6.3), small grains thought to represent an early stage in the development of large-grained rice akin to modern domesticated varieties. The same organic deposits also produced a variety of wooden spades and pestles.

In addition to cultivating rice, the farmers of Bashidang also collected a wide variety of wild plants and hunted several species of deer. There are some claims that pig, fowl, and even water buffalo were domesticated, but little

Fig. 6.3. Carbonized rice from Bashidang (photograph kindly provided by Pei Anping)



detail has been published about the morphology of the remains on which these claims can be judged, and it is more likely that little animal husbandry was practised. These people seem to have been hunters, gatherers, and rice cultivators, in some respects comparable to PPNA wheat/barley cultivators in South-West Asia. On the other hand, evidence for one structure being much larger than the others at Pengtoushan, along with the separate cemetery zones, and the enclosure wall at Bashidang, combine to suggest that from the outset these sedentary Yangzi farming communities were socially differentiated, like PPNB communities in South-West Asia.

Rather similar villages—over 70 have been identified, of which Peiligang is the best known—are found clustered on the foothills of the loess highlands of the middle Huanghe valley from the middle of the seventh millennium BC. These communities combined foraging with millet farming and possibly stock-keeping. The sites are more extensive than the Yangzi villages, generally 1–2 hectares in size, but mostly with simpler domestic structures: small round houses 2–3 metres in diameter with sunken floors, though more substantial rectangular houses are also found. There are also storage pits, pottery kilns, and separate cemeteries with scores of burials (over a hundred at Peiligang). The technology included stone axes and spades, sickles including mussel shells with serrated edges (Fig. 6.4), querns, and four-legged grinders, together with coarse low-fired pottery decorated with simple impressed and incised designs.

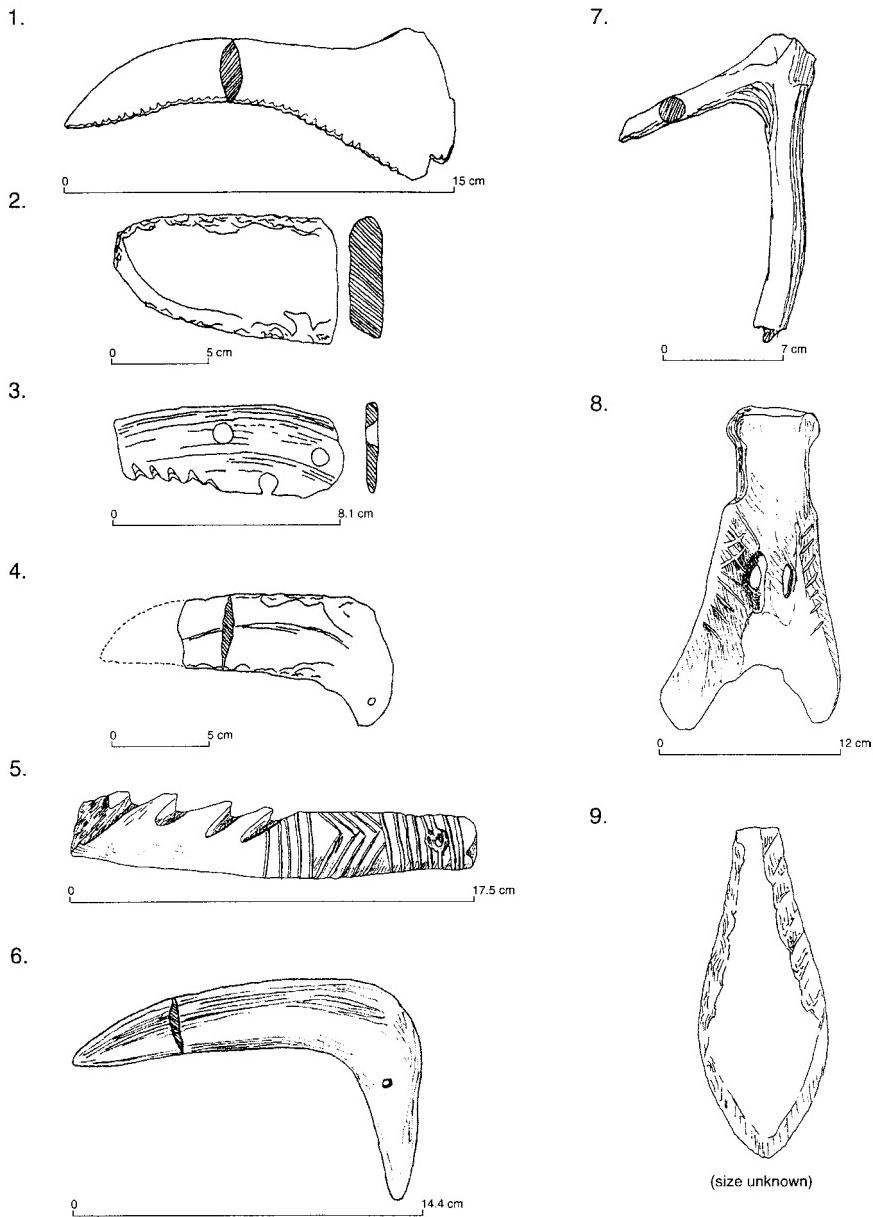


Fig. 6.4. Agricultural tools from early Neolithic sites in China: 1. stone sickle, Peiligang; 2. stone sickle, Lilou; 3. shell sickle, Baijia; 4. shell sickle, Beixin; 5. bone sickle, Hemudu; 6. bone sickle, Dawenkou; 7. bone hoe, Zhishanyan (Taiwan); 8. bone spade, Hemudu; 9. stone spade, Hulijingzi (Underhill, 1997: fig. 4; illustration by Bryan Natinsky, kindly provided by Anne Underhill)

The main crops grown were the millets, both foxtail and broomcorn: at Wu'an, for example, storage pits contained over a hundred cubic metres of foxtail millet, and studies of the carbonized foxtail millet at Dingzhuang showed it to be like its modern equivalent in size (D. J. Cohen, 1998). Isotope studies of skeletons indicate that C4 plants (see Chapter 3, pp. 94–5) such as millet provided the mainstay of the diet, though other plant remains reported include Chinese cabbage (*Brassica campestris*), peach, walnut, Chinese dates, and hackberry (Crawford, 1992b; Underhill, 1997; Zhimin, 1989). There is also evidence for domestic pigs, dogs, and chickens (West and Zhou, 1988), and perhaps water buffalo. Nevertheless hunting, like plant gathering, certainly remained important: microlithic hunting technology is common, together with bones of water deer, Sika deer, waterfowl, and so on.

It has commonly been argued that Peiligang farmers practised swidden farming (cutting and burning clearings in the forest, growing crops for a few years until yields fell, and then abandoning the clearing and moving the crops to a new cleared area), but this is unlikely. Swiddening is primarily a strategy for tropical soils where nutrients are quickly expended and long fallowing is necessary to restore fertility. This is not the case on loess soils, and experiments show that, even without fallowing or manuring, they can sustain reasonable cereal crops for generations, and by combining short-fallowing, manuring, and green crops, farmers can maintain high yields indefinitely (Rowley-Conwy, 1981b). The loess soils of Europe and China, the latter hundreds of metres deep in places, have remained the breadbaskets of their regions for millennia. It is more likely that Peiligang farmers, like later farmers in the Huanghe basin, grew their crops on small permanent fields beside their settlements on the fertile river terraces they occupied, sowing their crops in the autumn on waterlogged ground once the floodwaters receded. Certainly the shedding ages of the deer antlers at these sites suggest multi-season occupation, probably all-year-round.

One of the most informative sites about the possible relations between the southern rice and northern millet farming communities is Jiahу in Wuyang county, on the southern edge of the Huanghe basin. This was a substantial settlement of houses, pits, kilns, and more than 300 graves. The material culture of the site is like that of Peiligang, the technology including spades, sickles, knives, and milling equipment, but unlike at Peiligang the people of Jiahу were growing both millet and rice. The occurrence of rice stalks, leaves, and chaff makes it far more likely that the rice was grown there, not traded in from further south (D. J. Cohen, 1998). Isotope analysis also suggests the consumption of both C3 plants such as rice and C4 plants such as millets (Zhang and Wang, 1997). Jiahу and Pengtoushan are about 600 kilometres apart, about half the distance separating the Levant from the Zagros, but specific artefacts are identical, particularly food preparation

items such as double-eared round-bottomed *hu* vessels and tripod cooking stands.

With the palaeoenvironmental data indicating less differentiation between the Huanghe and Yangzi valleys than today during the mid-Holocene, the likelihood is that rice and millet cultivation developed in a more or less synchronous manner through the early Holocene. Both rice and millet had been an important food source for late Pleistocene foragers in China, and were clearly being exploited with increasing intensity in the early Holocene at sites like Xianrendong (rice) and Nanzhuangtou (millet). Higham (1995) argues that the initial phase of sedentary Pengtoushan and Peiligang settlement was probably sustained by intensive gathering, albeit increasingly interventionist in character, with people only developing systematic cultivation in the context of climatic deterioration after about 6000 bc. 'Climatic deterioration encouraged increased concern for stabilizing the resource base among sedentary foragers, a trend that saw rice and millet favoured and brought into domestication' (Higham, 1995: 146–7). At variance with this theory, though, is the fact that both rice and millet were manifesting significant morphological changes before this time, suggesting that (my own reading of the data) the beginnings of horticulture in China were significantly earlier.

In a well-known experiment, Oka and Morishima (1971) planted two plots of wild rice, harvesting and reseeding one and leaving the other to ripen, shatter, and self-seed. After only five generations, the harvested and planted rice increased in weight and spikelet number and reduced the rate of seed shedding. The implication seemed clear, that human intervention would lead rapidly to morphological changes in the plants. In prehistory, though, if wild rice was simply shaken or beaten into a container, with some of it falling to the ground to reseed, it could have remained little affected by human exploitation for a long time. On the other hand, harvesting with the sickle, as at sites like Xianrendong very early in the Holocene, could rapidly have encouraged genetic and morphological changes leading to domestic phenotypes. The increasing aridity that followed the peak of the early Holocene climatic amelioration would presumably have been less favourable to grasses, and sedentary societies relying on them might have needed to alter their subsistence strategies to deal with changes affecting their staple foods. However, it is currently difficult to see any neat coincidence in China between climatic change and the emergence of systematic millet and rice farming, though the beginnings of horticulture appear to coincide more or less with the climatic transition to the Holocene.

Crop farming and animal husbandry were well integrated by the later sixth millennium bc, alongside the maintenance of hunting and gathering activities particularly at sites with access to wetland landscapes. The best example of the latter is Hemudu on the coastal plain east of Shanghai, at that time a

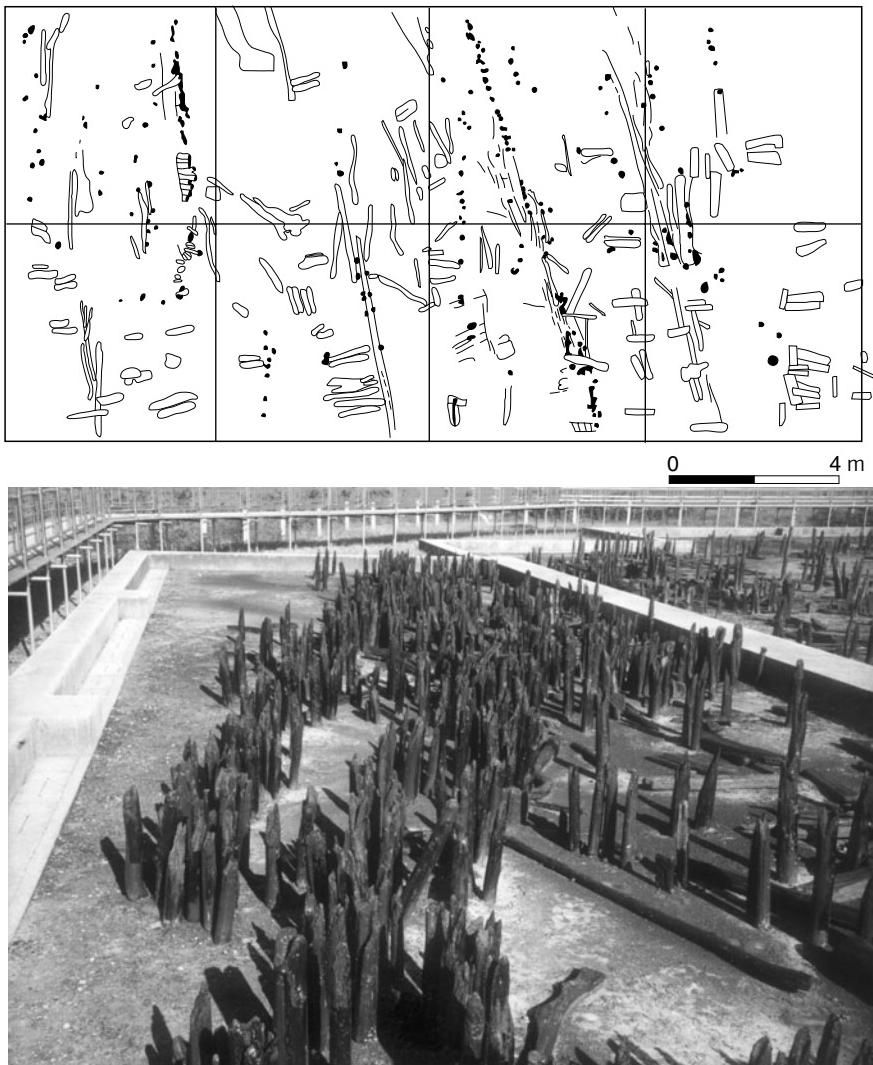


Fig. 6.5. Hemudu: (*above*) plan of remains of timber buildings, and (*below*) photograph of the wooden posts of the settlement (plan after K.-C. Chang, 1986: fig. 172; photograph kindly supplied by Judith Cameron)

mosaic of forests, pastures, streams, lakes, ponds, and marshes. The water-logged conditions preserved organic materials well. The settlement consisted of an orderly series of timber longhouses built on piles at the water's edge, their construction demonstrating the development of accomplished carpentry including mortise and tenon joints (K.-C. Chang, 1986: 208–14; Zhao and Wu, 1986–7; Fig. 6.5). A wide variety of artefacts were made in wood, bamboo,

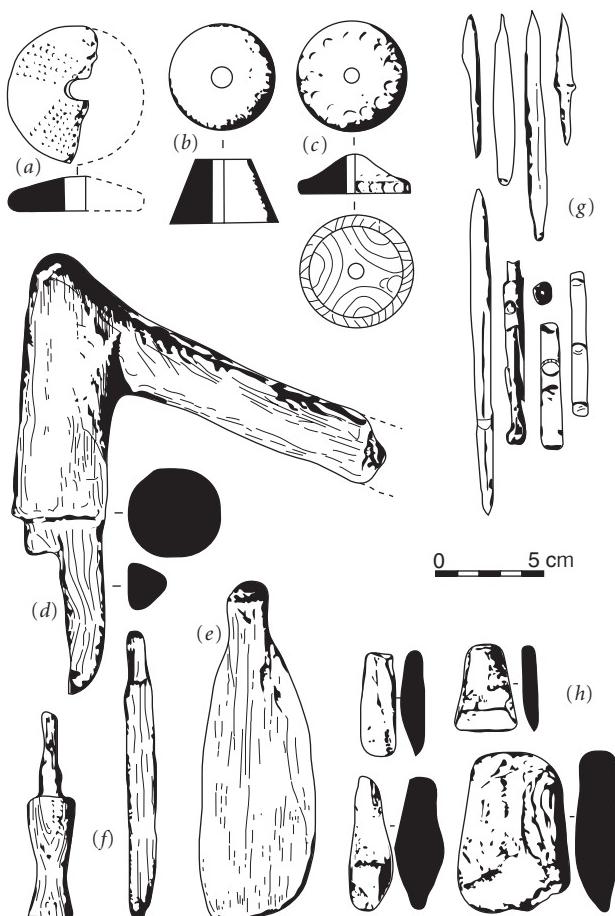


Fig. 6.6. Artefacts from Hemudu: (a–c) perforated clay discs, possibly spindle whorls; (d) wooden adze handle; (e) wooden spade blade; (f) unidentified wooden objects; (g) bone points and whistles; (h) stone adzes (after Bellwood, 1997: fig. 7.2, redrawn with his kind permission)

and bone including fish-hooks, arrowheads, chisels, awls, needles, weaving shuttles, hoes, spears, mallets, spades, and paddles (Fig. 6.6). Spades were also fashioned by lashing wooden handles to the scapulae bones (shoulder blades) of water buffalo. Simple pottery was made, thick and porous, decorated especially with cord impressions, the shapes indicating primary use for cooking and storage. The food harvested from the forests, lakes, streams, and marshes around Hemudu included acorns, water chestnut, waterfowl (crane, heron, duck, egret, cormorant), shellfish, fish (mainly carp), elaphure, nycteutes, muntjak deer, water deer, sika deer, rhinoceros, elephant, alligator, tortoise, and turtle. This (very) broad-spectrum hunting, however, was integrated with well-developed plant husbandry. An enormous quantity of domestic rice was found: stalks, husks, leaves, and grains, in places a metre thick, the evidence of weight, size, thickness, glume hairs, and so on making it clear that the rice was



Fig. 6.7. Plan of Yang-shao village at Jiangzhi (after K.-C. Chang, 1986: fig. 68)

morphologically fully-domestic, in fact just like modern rice (Higham, 1995). The community also kept domestic pigs and very probably water buffaloes as well as dogs. Although there is no direct evidence for paddy fields, the evidence for the scale and effectiveness of rice farming, the fully domesticated state of the rice grains, and the artefacts such as the spades, can be taken to suggest that Yangzi farmers by this date had probably started true wet-rice cultivation, building bunded fields and using dikes and ditches to flood and drain the rice crop like modern rice farmers in China.

Later Neolithic settlement in the Yangzi valley, after c.5000 BC, continued much as before. Villages such as Majiabang were like Hemudu, pile-dwelling lakeside settlements with a similar range of material culture and food refuse (K.-C. Chang, 1986: 197–201). In the Huanghe valley, however, the Yang-shao villages (now known to date to c.5000–3000 BC, not c.3500–2500 BC as once

thought), represent a quantum leap in complexity from the earlier Neolithic Peiligang sites. Sites such as Banbo and Jiangzhai are several times larger than Peiligang, and carefully planned. Jiangzhai, for example, had almost a hundred houses arranged in a circle around a central courtyard, enclosed within a ditch and palisade (K.-C. Chang, 1986: 116–19; Fig. 6.7). The houses were round or square, with plastered floors cut into the loess subsoil, post frames, wattle and daub walls, and thatch roofs. The pottery indicates the first use of the slow wheel, and specialized craft knowledge was involved in painting and firing vessels. There were also highly developed skills in basketry and weaving, and in the cultivation of hemp and the silk-worm; some sites have produced silk thread, ribbon, and fabric. Evidence for hunting, fishing, and gathering remains prolific, but the mainstay of the subsistence system was millet cultivation and pig breeding. As well as dog, chicken, and water buffalo, Yang-shao farmers also kept sheep, goats, and cattle in small numbers. Areas of the settlements were reserved for specific activities such as penning animals, storing food, and firing pots. At Jiangzhai, for example, there was a single large building positioned by a ramp leading to the cemeteries outside the settlement, with evidence that it was used for elaborate rituals associated with the passage of the dead. Differences in the cemetery layout, in the human remains, and in the grave-goods, indicate that the society was carefully divided into distinct lineages or clans, with marked social differentiation within these. We can see now in the central Huanghe valley the beginnings of a trajectory of social stratification, technological development, economic intensification, and demographic expansion that was to culminate in the Shang state.

TRANSITIONS TO FARMING IN KOREA AND JAPAN

Though there have been reports of carbonized grains of domesticated rice at Sorori in South Korea dated to c.15,000 BP, the rest of the archaeological record indicates that people in the Korean peninsula lived as hunter-fisher-gatherers up to the middle Holocene, at which point they started augmenting their subsistence with plant cultivation, it is presumed from contact with farming communities in mainland China. Archaeologically these Holocene foragers are defined as the Chulmun culture. There is little detail from excavations, but most Chulmun sites occupy riverside locations, yielding food remains including forest game such as red deer and wild boar, fish such as salmon, shellfish, and plant remains such as nuts. The settlements are rather substantial, though, with pit houses, storage pits, and ceramic containers. It appears that the harvesting and storage of these resources were sufficient to sustain more or less sedentary communities (Bellwood and Barnes, 1993).

Pollen diagrams show small-scale forest clearances in Korea by the mid-Holocene (Crawford, 1992b), which is also when there are the first definite indicators of cultivation in the archaeological record (Bale, 2001). Phytoliths thought to be of domestic rice have been identified at Juyupri c.4400 BC, seeds of foxtail millet associated with seeds of broomcorn millet from the site of Tongsamdong in southern Korea have been AMS-dated to 3360 cal. BC (Crawford and Lee, 2003), and grains of domestic rice have been found at Kawaiji dating to c.3000 BC (Crawford and Shen, 1998). The assumption is that these Korean foragers acquired millets and rice (and the knowledge of how to cultivate them) by trading contacts with the Xinle forager-farmers of southern Manchuria to their north, who in turn were in trading contacts with the Yang-Shao farmers of the Huanghe, but nothing really is known of the context in which domesticates were incorporated into Chulmun subsistence. The major commitment to food production in Korea seems to have been in the later second millennium BC, when the adoption of bronze metallurgy coincides with evidence for the rather sudden development of integrated systems of mixed farming, including wet-rice cultivation using water buffaloes (Bellwood and Barnes, 1993; Crawford and Lee, 2003).

From the beginning of the Holocene, there is evidence throughout the Japanese islands for dense populations of foragers, generally referred to as Jomon (Habu, 2004; Kobayashi, 2004). Estimates suggest more than 75,000 sites (Rowley-Conwy, 1984). Jomon means 'cord-marked', referring to the fact that these societies used pottery with cord decoration. The first pottery so far known—crudely made and finished vessels, not in fact cord-decorated—has been found in caves and rock shelters such as Fukui and Kamikuroiwa, dating back as early as about 10,000 BC in the Younger Dryas. However, pottery only became common after about 7000 BC, coinciding with evidence for the increasing importance of plant foods in the diet in the form of both plant remains and grinding equipment. Presumably pottery's growing importance reflected the need for effective storage technologies (Aikens, 1995; Imamura, 1996). Jomon foraging systems lasted for almost 10,000 years, a long tradition which has been divided by Japanese archaeologists into six phases: Incipient (c.10,000–8500 BC), Initial (c.8500–4000 BC), Early (c.4000–3500 BC), Middle (c.3500–2500 BC), Late (c.2500–1000 BC), and Final (c.1000–400 BC).

In the early Holocene, the climate on the Japanese islands was cool and temperate, and the dominant vegetation was deciduous broad-leaved forest, with trees such as chestnut, walnut, and hazelnut (Tsukada, 1986). The most visible, and hence most frequently investigated, early Jomon sites are coastal shell middens, some of them hundreds of metres in extent, but large numbers of inland sites are also known (Matsui, 1995; Rowley-Conwy, 1984). Excavations have found evidence for dwellings set amongst the shell mounds. A good

example of an Early Jomon coastal settlement is Yagi on the northern island of Hokkaido (Breed *et al.*, 1989). The settlement was located on a terrace overlooking the sea, with mountains behind. At the time of the site's occupation, the latter were probably covered in beech forest with a shrub layer of maples and bamboo grass. Excavations found remains of five domestic structures, in part cut into the subsoil, and geophysical survey indicated that there were probably three times as many. There were also large pits amidst the middens, post-hole settings suggesting a variety of racks and scaffolds, and burials. The fauna found in the rubbish deposits included various terrestrial species such as sika deer, together with a large number of large marine species (seal, sea lion, walrus, shark, dolphin, and porpoise), sea birds (albatross, auk, cormorant), and fish (salmon, skate). From an assessment of the likely resources around the site, as well as the species actually identified from the middens, the excavators concluded that the site could have been occupied throughout the year, the primary meat species being sika deer and sea mammals, augmented by small game such as hare, waterfowl, river and sea fish, shellfish, and plant foods. The body parts represented indicate that animals were butchered and consumed at the site, suggesting that the community was not being supplied by meat brought back from distant hunting stations, which is surprising given the status of the site as an all-year-round residential focus.

It is clear from sites like Yagi that Jomon foragers had effective technologies for deep-sea hunting and fishing. Artefacts surviving include wooden bows, bone fish-hooks, fish spears, net sinkers, dugout canoes, and paddles. The coastal resources harvested in Tokyo Bay included seven species of bird, eleven mammals, seventeen marine fish, and 34 species of shellfish (Aikens, 1995: 15). The Jomon community at Shimotakabora was catching dolphin, turtle, parrot fish, chub mackerel, scad mackerel, opal eye, rock bream, moray, and tuna (Imamura, 1996). The richness of Japan's coastal and marine resources was clearly a primary factor in sustaining dense and increasingly sedentary communities of foragers. The greatest density of Jomon sites is in fact in the north-east, the area of the greatest availability of dog salmon (*Oncorhynchus keta*) and trout (*Oncorhynchus masou*). The differing frequencies of the body parts of these species at different sites suggest highly organized systems of capture, processing, storage, transport, and consumption (Matsui, 1996). This was also the area where the Ainu survived as more or less sedentary foragers until the late nineteenth century, primarily as coastal foragers (Crawford, 1992a).

However, isotope studies of Jomon skeletons indicate that many coastal peoples also made extensive use of inland terrestrial foods (Chisholm, 1998), and here the picture is filled out by sites where plant remains have survived. For example, although shellfish dominate the food refuse at Torihama (as at

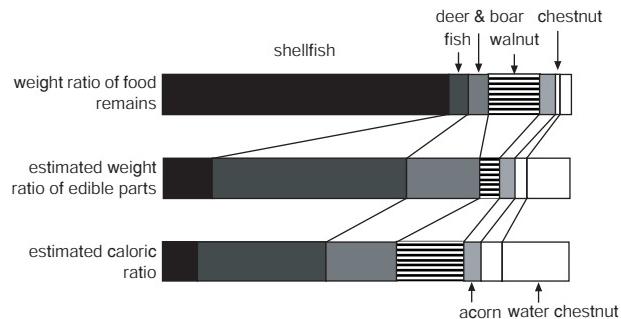


Fig. 6.8. Major components of subsistence, by weight and calories, reconstructed from the food remains at Early Jomon Torihama (after Nishida, 1983: fig. 4)

most Jomon sites) in terms of weight, the calculation of the calorific contribution to the diet of the various food remains indicated that plant foods probably made up almost half of the diet (Nishida, 1983; Fig. 6.8). Chestnuts and walnuts occur with increasing frequency through time; water chestnuts were also widely collected. The paucity of beechnuts implies that primary forest was little exploited, and acorns are also rather rare, presumably because they required so much leaching to make them edible. The plant species from Torihama included water chestnut, sweet chestnut, walnuts, red beans, burdock, hemp, paper mulberry, Chinese cabbage, melon, and two species that were probably introduced to Japan from Korea: bottle gourd (*Lagenaria siceraria*—used for containers), and buckwheat (*Aesculus turbinata*). Buckwheat pollen is in fact recorded in the Ubuka pollen diagram from this period. Another exotic plant now recorded is the peach, at Ikiriki (Crawford, 1992b). There is also evidence that the indigenous barnyard grass (*Echinochlea crusgalli*) was being collected intensively by Early Jomon foragers (Crawford, 1992a).

Palynological evidence for forest clearances in the Early Jomon period has led to suggestions that people were clearing patches of forest not just to encourage secondary vegetation growth for the deer they were hunting but also for transplanting edible seeds for themselves (Crawford, 1990, 1992a), much as is argued for contemporary Mesolithic foragers in north-west Europe (Zvelebil, 1994; and see Chapter 9, p. 342). Akawaza (1982) suggested that such changes could be related to falls in sea level putting pressure on the marine economy, though it is difficult to see evidence for any major shift from coastal and marine foraging. Whilst the range of plant species now being found in Early Jomon sites indicates that these foragers were certainly in trading contact with the Chinese mainland, and were probably beginning to practise small-scale horticulture by the end of the Early Jomon phase, the rarity of digging implements suggests that, if gardens were being maintained, they were probably on a small scale. Certainly the clearances in the pollen

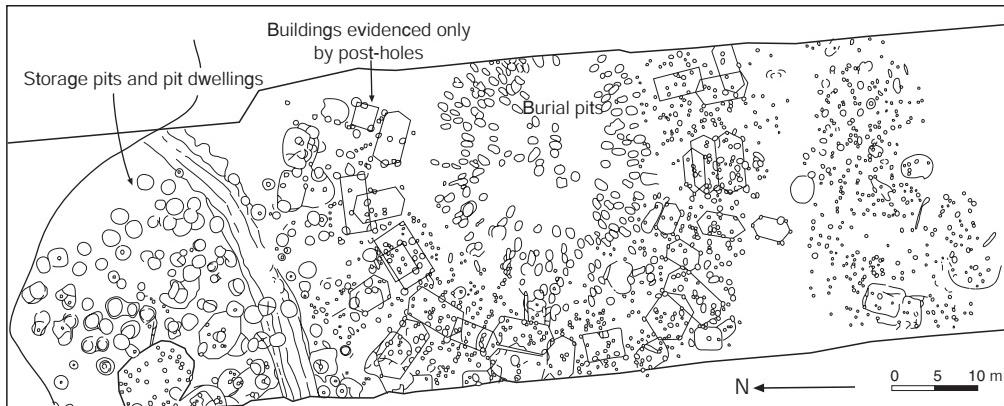


Fig. 6.9. Plan of Middle Jomon settlement at Nishida (after Imamura, 1996: fig. 24.5)

diagrams are tiny compared with the evidence for human impact on vegetation at the end of the Jomon period.

By the Middle Jomon period, settlements included large densely occupied permanent villages with clear internal structures (Aikens and Dumond, 1986). Nishida, for example, consisted of a collection of dwellings laid out in a concentric circle, with a cemetery area at the centre and storage pits around the periphery (Fig. 6.9). At Sannai Maruyama excavations for a baseball stadium found over 700 pit dwellings along with a dozen longhouses, over a hundred post-hole structures, and hundreds of burials (Habu *et al.*, 2001). The seasonal indicators (fish-bones for example) at the latter site indicate all-year-round settlement, and calculations of occupation phasing suggest that 50–100 pit dwellings were in use at any one time (the occupation of the site spanned two millennia, from c.6000 to 4000 BP), with a population of 200–500 people. Material culture at Sannai Maruyama included enormous quantities of pottery and lithic tools (arrowheads, scrapers, grinding stones, mortars), bone and wooden tools, wood containers, lacquer ware, basketry, cordage, textiles, and exotic materials such as amber, asphalt, obsidian, and jade. One of the most remarkable discoveries was a setting of six enormous (1 metre diameter) chestnut posts, which reconstruction has shown was aligned on the midwinter sunset (Habu, 2004: 113).

Middle Jomon subsistence increasingly involved plant tending as well as foraging. At Usijiri, for example, barnyard grass was collected very intensively, and there are morphological changes indicative of domesticated millet (Crawford, 1992a). Seeds of foxtail millet have also been found, and there was a single grain of buckwheat at Hamanasuno. The plant remains at Nishida included green grams (*Vigna radiata*), the seasoning perilla

(*Perilla frutescens*), and bottle gourd (*Lagenaria*) (Imamura, 1996). Cultigens at Sannai Maruyama included barnyard grass, bottle gourd, burdock (*Arcium*), and bean (*Leguminosae*). Although none of these plants is a staple, cumulatively they are indicative of Middle Jomon foragers' growing commitment to horticulture, as is the evidence for the cultivation of the beef-steak plant, a member of the mint family (Higham, 1995). An abundance of *Sambucus* and *Morus* berries at Sannai Maruyama, together with numerous chrysalises of *Drosophilidae* (fruit fly) indicating that the fruits were fermenting, may be evidence for the brewing of fruit wine.

By c.1000 BC, people at Late Jomon Kazahari were consuming morphologically domestic rice, broomcorn millet, foxtail millet, and a range of small grass seeds, and were probably more actively cultivators than they were foragers (Crawford, 1992a). The cemetery evidence shows that these Late Jomon societies were increasingly segmented, divided into households, and with further marked gender differences within the household units (Harunari, 1986; T. Kobayashi, 2001). The isotope studies also indicate dietary differences that are gender-specific (Chisholm, 1998).

The succeeding Yayoi period has been commonly interpreted by Japanese scholars as a major population incursion from the mainland, on the evidence of a very rapid spread of Yayoi material culture from the south-west up through most of Japan, but more recent readings of the evidence envisage the development of the complex administrative structures and trading networks that characterized the period in terms more of internal social and economic transformations (Crawford, 1992a, 1992b; S. Kobayashi, 2001). It certainly marked a major transformation in farming technology, with the rapid spread of metallurgy and wet-rice cultivation (Tsude, 2001). Knowledge of both probably reached Japan by a process of island-hopping to Kyushu, the southernmost island nearest to Korea: the metal cultivation tools and stone reaping knives used in Yayoi rice farming all closely mirror East Asian forms.

The pollen diagrams show a huge increase in the scale of clearance coinciding with the Yayoi period. The mix of crops in the botanical record includes rice, the millets, wheat, and barley, together with crops such as apricot, soy-bean, pea, peach, persimmon, plum, pear, and watermelon. Taken together, the evidence suggests that the Yayoi economy rested on intensive systems of multi-cropping (Crawford and Takamiya, 1990; Crawford and Yoshizaki, 1987). Traces of paddy fields have been found at hundreds of Yayoi sites: field boundaries, the impermeable plough pans that floor the fields, sediments full of rice phytoliths (Barnes, 1990), and even in some instances the root holes of the rice seedlings (Imamura, 1996: 456). Itatsuke is a good example of an early Yayoi rice farm (Imamura, 1996; Fig. 6.10). It was built on a terrace

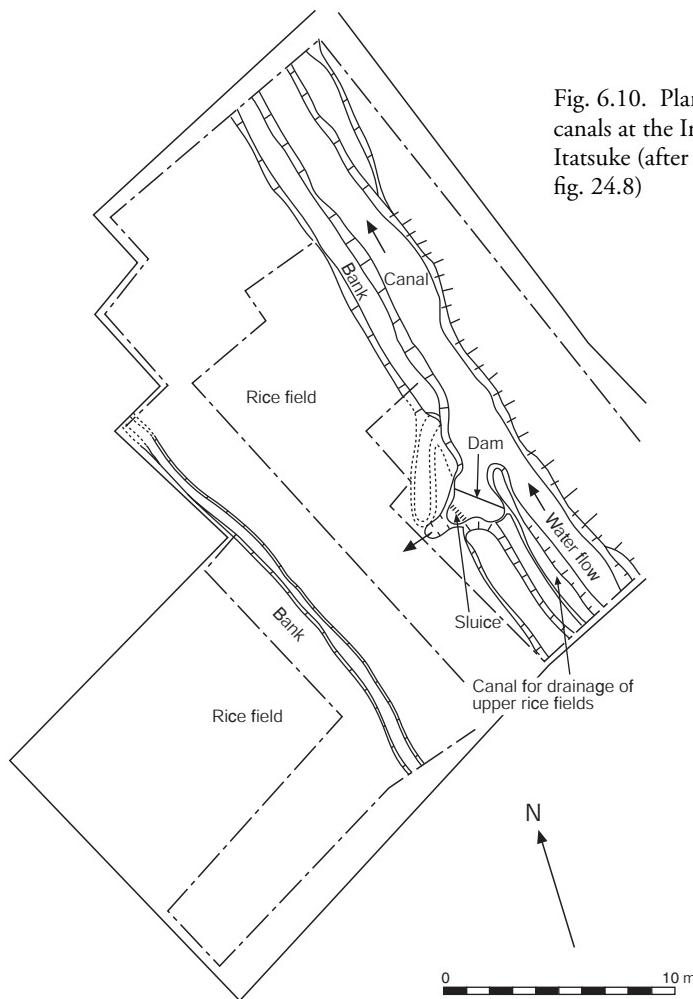


Fig. 6.10. Plan of rice fields and canals at the Initial Yayoi site of Itatsuke (after Imamura, 1996: fig. 24.8)

overlooking its rice fields laid out on a lower terrace. Water was brought to the paddy fields by an upper canal, and then drained out into a lower canal.

PLEISTOCENE RAINFOREST FORAGING IN SOUTH-EAST ASIA

The landscapes of South-East Asia at the Last Glacial Maximum were remarkably different from those of today. The most striking transformation was the result of sea-level lowering caused by the maximum growth of the world's

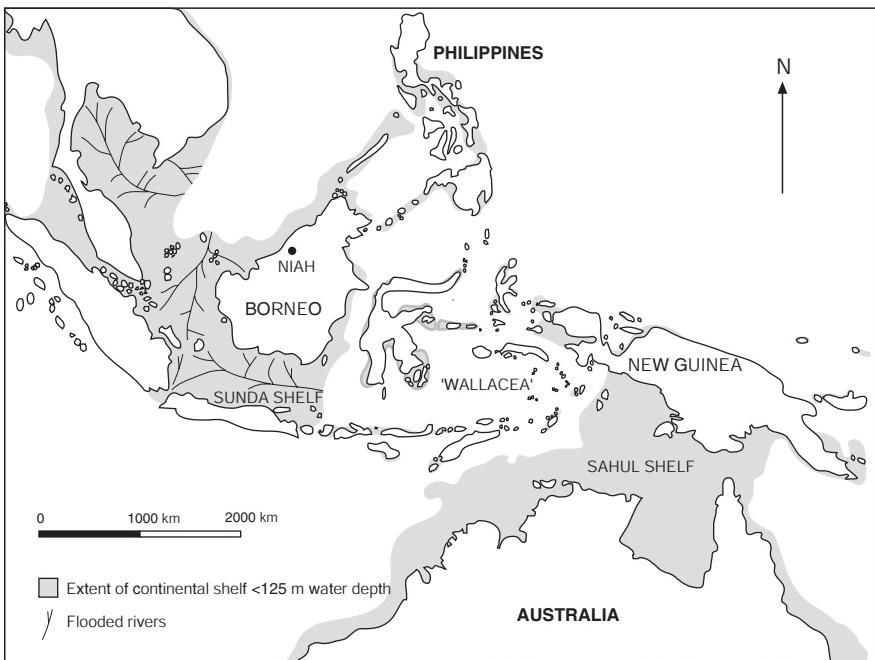


Fig. 6.11. South-East Asia at the Last Glacial Maximum, showing the dramatic effects of lower sea levels

glaciers. It connected the Philippines, Borneo, Java, and Sumatra to mainland South-East Asia, and New Guinea to Australia, creating the vast coastal plains of (respectively) the Sunda and Sahul Shelves (Kershaw *et al.*, 2002; Voris, 2000; Fig. 6.11). The Yangzi delta would have been some 600 kilometres further east from its present position, and the exposure of the Sunda shelf almost doubled the size of what is now mainland South-East Asia. With air temperatures 6–7° lower than today, and precipitation reduced by 30–50 per cent, the humid dipterocarp rainforest and mangrove swamp forests that now cover lowland areas in the Malaysian peninsula and Borneo were restricted especially to the now-flooded shelf-plains; steppe and grassland vegetation was extensive on the present-day lowlands; and montane rainforest now above 1,000 metres above sea level descended to lower elevations (Kershaw *et al.*, 2001). Mountain species such as the Lesser Gymnure and the Ferret Badger that now live on Mount Kinabalu are found in LGM sediments at Niah Cave on the coastal plain of Sarawak, northern Borneo (Cranbrook, 2000). The Highlands of New Guinea were also cooler and cloudier than today, with lower tree-lines and greatly expanded grasslands (Hope and Golson, 1995).

There has been a long-running debate amongst anthropologists and archaeologists about whether prehistoric foragers had the knowledge and technologies to exploit rainforest effectively (e.g. Bailey and Headland, 1991; Bailey *et al.*, 1989; Colinvaux and Bush, 1991; Endicott and Bellwood, 1991; Townsend, 1990). A prominent view has been that tropical rainforests are difficult or impossible for foragers to live in because edible plant and animal species are widely dispersed (not just horizontally but also in terms of their location between the forest floor and the tree canopy) and are mostly in small 'packages' rather than clusters, making foraging costs high. Also, the densities of critical plant foods such as wild yams may be very low in undisturbed rainforest (Kuchikura, 1993). Hence rainforest foragers today invariably augment their subsistence by trading forest products with neighbouring communities for food or cash, like the Bornean Penan's trade in birds' nests and hornbills with the Chinese (Beavitt, 1992), and/or they practise systems of forest 'management' that have many similarities to horticulture (Lourandos 1997; and Chapter 2, pp. 63–4). One of the best-known examples of the latter is the way the Penan manage and protect the sago trees that provide their staple carbohydrate (Brosius, 1991; Fig. 2.7). One of the difficulties with using modern rainforest foraging as a guide to the past, though, is that in some situations hunting and gathering may enhance the distribution and availability of edible resources in rainforest, so the current dearth may in part reflect reduced foraging in recent centuries rather than the nature and density of animal and plant food in earlier rainforests. In fact, the archaeological record of South-East Asia is producing remarkable evidence for the complexity of late Pleistocene foraging, including rainforest management strategies.

The West Mouth of Niah Great Cave (Fig. 6.12) is famous for the excavations there by Tom and Barbara Harrisson in the 1950s and 1960s, especially for their discovery of a human skull in deposits that yielded a 14C date of *c.*40,000 BP, making it the earliest modern human in South-East Asia (Brothwell, 1960; Harrisson, 1958, 1970). A renewed programme of excavation has confirmed the broad antiquity of the human fossil, and shown that modern human foragers had probably started to visit the cave by about 45,000 years ago, in environments that, whilst certainly very different from those of today, almost certainly included rainforest (Barker, 2005; Barker *et al.*, 2002). The faunal remains from the original and new excavations indicate that these foragers were hunting a wide range of larger prey species such as pig (*Sus barbatus*, the Bearded Pig), various primates, porcupine, monitor lizard, and turtle, together with an array of smaller species such as langurs and macaques, snakes, lizards, swiftlets, insectivorous bats, and fish, the latter including large freshwater and estuarine species probably caught by nets and traps as well as spears (Cranbrook, 2000; Medway, 1960, 1977). They also

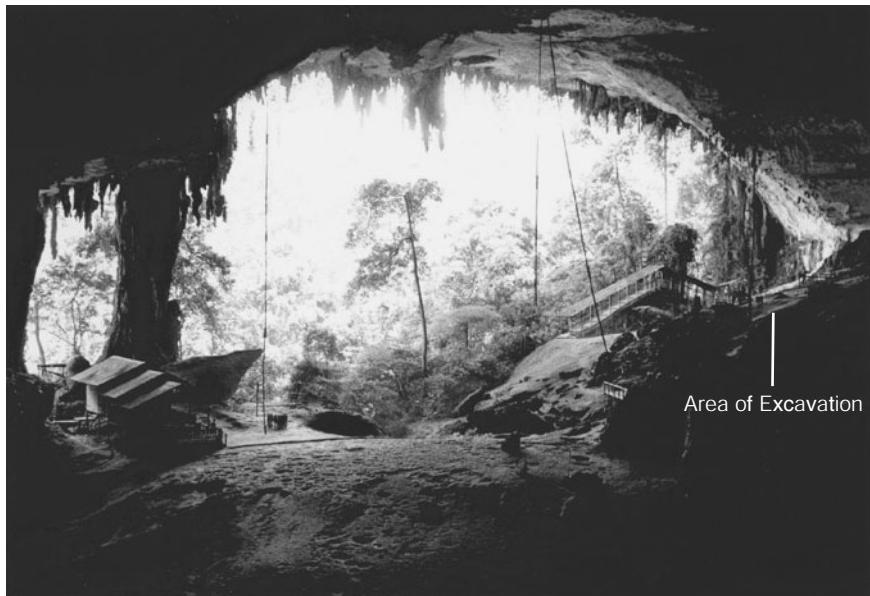


Fig. 6.12. The West Mouth of Niah Great Cave, showing the location of the archaeological zone (photograph: Graeme Barker)

collected molluscs from local streams, and from estuarine mangrove forests. However, the new excavations have also produced remarkably well-preserved evidence for plant exploitation, in the form of fragments of fruits, nuts, plant tissue (parenchyma), and grains of starch (Barton, 2005; Paz, 2005). The data indicate the collection from the rainforest, processing and storage in the cave, and presumably consumption, of high-energy carbohydrate plants, many of which require careful processing to make them digestible, such as aroids, taro, yam, and even sago palm, the Penan staple today (Figs 3.6 and 3.7).

Microwear studies of bone and tusk tools from Niah, compared with microwear damage on experimental and ethnographic examples, show that several classes of tools were being manufactured specifically as implements for digging activities (Rabett, 2005). The presence of starch of an aroid as yet unidentified to species, but likely to derive from *Alocasia denudata*, a local species used by recent foragers as poison for their blow-pipe darts, is a further hint that the technology of rainforest hunting known ethnographically might also be of great antiquity. High pollen frequencies of *Justicia* (Acanthaceae), the first plant to colonize burnt areas in the local forests today, are strongly suggestive of forest-burning (C. Hunt, *pers. comm.*), an activity which would have enhanced the amount of plant food available for both

animals and humans. In combination, the Niah evidence suggests that many of the characteristic strategies and technologies practised in recent times by rainforest foragers in South-East Asia could well be, in their essentials, as old as the region's colonization by modern humans, facilitating the successful exploitation of rainforest as well as other environments. Ocean-floor cores taken north of Borneo in fact document a twofold increase in charcoal around the time that humans were colonizing island South-East Asia (Beaufort *et al.*, 2003).

The Niah evidence chimes with evidence elsewhere in island South-East Asia for the sophistication of colonization and forest management strategies by Pleistocene foragers. From the beginning, people seem to have recognized the advantages of nurturing useful plants where they grew naturally, or grouping them in useful locations and preparing the ground for them (J. P. White, 1993). The genetic modifications that affected the *Canarium* tree before the end of the Pleistocene were probably the result of such activities (Cosgrove, 1996; A. Smith, 1995). Starch grains on stone tools from Kili in the northern Solomons probably derive from the processing of taro corms 28,000 years ago (Loy *et al.*, 1992; Pavlides and Gosden, 1994). The highland forests of New Guinea were disturbed by clearance and burning from at least 30,000 years ago (Hope, 1982; Hope and Golson, 1995). Waisted axes from Kosipe and the Huon peninsula, of similar antiquity, were presumably used to effect such clearances (White *et al.*, 1970; Fig. 6.13), in what Groube (1989: 300) termed a 'strategy of minimal manipulation to enhance the growth of existing forest food plants' such as bananas, swamp taro, *Pandanus*, and sago. Intensive shellfish collection was practised where possible, for example at Lachitu Cave near Vanimo on the northern coast of New Guinea (J. P. White, 1993). Hunting strategies could be surprisingly selective, on the evidence of the mortality profiles of the Brown Dorcopsis wallaby (*Dorcopsis muelleri*) hunted from caves in the Bird's Head peninsula of north-west Papua (Pasveer, 2003) and of cuscus (*Phalanger orientalis*, a kind of wallaby) hunted from Buang Merabak cave in New Ireland (Leavesley, 2005).

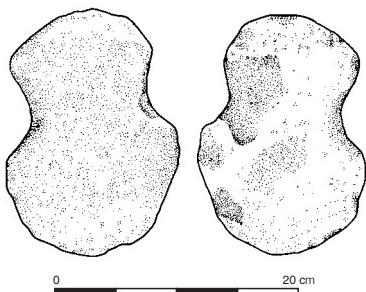


Fig. 6.13. c.30,000-year-old waisted axe from Kosipe, New Guinea (after Groube, 1989: fig. 17.1)

Such strategies allowed people to settle East Timor by c.35,000 years ago (O'Connor *et al.*, 2002a) and island Melanesia in the Bismarck Archipelago by c.30,000 years ago, the latter involving sea journeys of at least 150 kilometres (Gosden, 1992; A. Smith, 1995). Most remarkably, Pleistocene foragers may have deliberately enriched the food resources of some of these islands, for example taking the cuscus to Matenbek on New Ireland c.20,000 years ago (Allen *et al.*, 1989; Gosden, 1995). Fragments of obsidian from a source 350 kilometres away, involving a 30-kilometre sea crossing, are another indicator of these people's ability to travel long distances and move resources about in their favour. Some 50,000–40,000 years ago (on the most reasonable interpretation of the current dating evidence), such technologies and the mental templates in which they were embedded also took these foragers southwards over the Wallace Divide to Australia (Allen, 1993; O'Connell and Allen, 2004).

TRANSITIONS TO FARMING IN MAINLAND SOUTH-EAST ASIA

The early Holocene pollen record for mainland South-East Asia marks a clear shift from the hot and dry conditions of the Late Glacial to warm and moist monsoonal weather, though with fewer indications of significant climatic oscillations than in mainland China (Maloney, 1992, 1998). The most dramatic environmental change was the flooding of the shallow Sunda Shelf, creating the present-day coastline by about 6000 bc. The inundation of what had been enormous deltas in areas such as the Gulf of Siam and the Gulf of Bac Bo (Tonkin) must surely conceal a rich coastal archaeology, and it is not surprising that the regional archaeological record for the early Holocene is dominated by inland caves and rock-shelters. These provide evidence for occupation by people using the Hoabinhian technology of flaked river pebbles, sometimes edge-ground, as well as stone mortars and pounders. The simplicity of this industry should probably not be taken at face value, though: edge-damage studies suggest that much of it probably relates to the production of a wide variety of other tools in bone, wood, and bamboo (Fig. 6.14). The technology was used for broad-spectrum foraging. In caves in and around Hoa Binh province in Vietnam, for example, the food refuse included wild cattle and water buffalo, rhinoceros, deer, forest birds, water turtle, tortoise, crabs, shellfish, and fish (Colani, 1930; Higham, 1989a: 35–43).

The distribution of Hoabinhian sites indicates that the interior of mainland South-East Asia was actively settled (Bellwood, 1997: 157). This may at first seem surprising, because monsoonal forests and parklands would have been characterized by increasingly dense vegetation at this time, with diminished

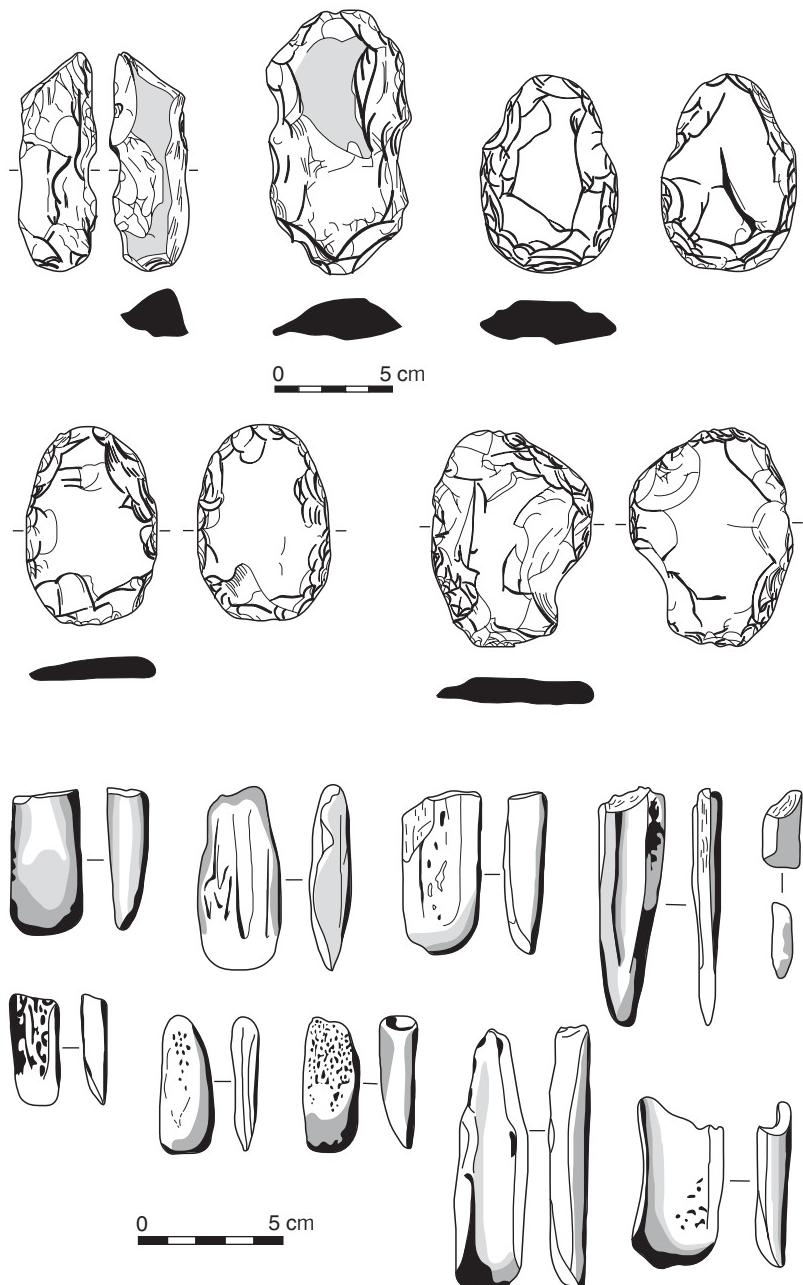


Fig. 6.14. Hoabinhian artefacts: (*above*) stone tools from Gua Cha; (*below*) bone tools from Gua Bintong (after Bellwood, 1997: figs. 6.2 and 6.3)

mammal biomass. Presumably the expansion of rainforest presented Hoabinhian foraging communities with increasingly difficult landscapes to exploit, yet clearly they devised successful strategies. One of the most important areas where we can observe such strategies is in the upland evergreen forests of north-west Thailand, from excavations especially of three small rock shelters: Spirit Cave, Banyan Valley Cave, and Steep Cliff Cave.

Spirit Cave was used for prehistoric occupation from about 9000 BC to 5500 BC (Gorman, 1969, 1970, 1977; Solheim, 1970, 1972). It is a stiff climb up from the Khong stream below, but a very wide range of fauna was brought up to the shelter. The charring of the bones suggests that some of it was cooked there, some dried for later consumption. The people used a typical Hoabinhian technology of unifacially flaked stone tools (edge damage suggesting that many were used for the production of wooden implements), together with grinding stones. Pottery appears in the upper levels of the cave, made with the paddle and anvil technique and decorated with cord impressions, though recent AMS dating of resins on some of the sherds suggests that it may be intrusive (Lampert *et al.*, 2003). The animals identified in the food refuse included sambar deer and pig, bamboo rat, porcupine, macaque, gibbon, langur, slow loris, banded palm civet, marten, flying squirrel, and otter, together with crab and fish (Higham, 1977). Plant remains were also recovered, especially *Canarium* nuts, together with betel nut, butternut (*Madhuca*), *Euphorbiaceae* fruit and, from the upper levels, bottlegourd, beans, and peas. Other forest foods represented by seed shells or kernels included *Prunus* (almond), *Terminalia*, and *Castanopsis*. Clearly Hoabinhians knew how to harvest the forest for food, condiments, stimulants (betel nut), hunting poisons (*Euphorbiaceae* fruits), gums, and resins (butternut).

It was at first argued from these plant remains that the occupants of Spirit Cave were probably practising horticulture as well as foraging, using simple inundation systems to grow rice and root crops (Gorman, 1969, 1970; Solheim, 1972). However, later detailed archaeobotanical studies have advised caution (Yen, 1977, 1980): the main foods were natural foods of the forest, the rice seems to be late in the sequence and morphologically wild, and the legumes were not carbonized and consisted of just one fragment each, making it highly likely that they were recent intrusions, like the pottery. Nevertheless, as Higham (1989a: 53) points out, the combination of cordage, gums, resins, and poisons collected by the Spirit Cave Hoabinhians certainly shows that they had detailed knowledge of the forest, and were systematically harvesting it for plant food, as well as for materials to equip themselves with effective hunting technologies including traps and snares.

Steep Cliff Cave, as difficult to access as its name implies, produced a similar range of food remains as Spirit Cave from a sequence dated to c.5500–3500 BC.

So did Banyan Cave, in this case together with wild rice, dated from c.3500 BC to c.AD 1000 (Glover, 1985; Higham, 1977, 1979), and Laang Spean in the highlands of Cambodia (Mourer, 1977). Plant remains from the Ban Kao caves in the dry monsoon forest included staple foods and what are now traditional medicines: fruit shells and seeds of the palm *Licuala spinosa*, betelnut, black plum (*Eugenia cumini*—the fruits are edible, the bark has medicinal uses), seeds of croton oil plant *Croton tiglium*, used today as a purgative, and legumes (*Crotalaria bracteata*, *Phaseolus adenantha*, and *Phaseolus lathyroides*). Only the latter, however, were carbonized, so the others may be intrusive (Pyramarn, 1989).

In the Thai/Malay peninsula too, as in the Thailand mountains, there is evidence for broad-spectrum foraging in the early Holocene at caves such as Lang Rongrien and Moh Khiew in southern Thailand (D. Anderson, 1990) and Gua Cha and Gua Gunung Runtuh in Malaysia (Bellwood, 1997; Sieveking, 1954; Zuraina Majid, 1994). Gua Cha, for example, had a faunal sample dominated by pig (both *Sus scrofa* and *Sus barbatus*), together with various species of deer, monkey, gibbon, rat, squirrel, and a few fragments of rhinoceros and gaur, and shellfish. There were also flexed burials dusted with ochre, the amount of disease in the teeth of these individuals indicating a diet rich in fruit and honey as well as animal protein, with vegetable foods growing more important over time (Bulbeck, 1998). It is difficult to gauge to what extent these early Holocene foragers were sedentary. The rugged terrain, the food refuse from broad-spectrum hunting, and the evidence for a logistical component in these foraging systems (there was the same evidence at Banyan Cave and Steep Cliff Cave as at Spirit Cave that meat was being partly consumed on site and partly smoked for later consumption, presumably elsewhere), indicate mobility. It is quite likely that the greatest sedentism was achieved by those communities living in the coastal deltas that are now flooded.

Given the detailed knowledge of the forest implied by the plant remains, and the evidence that early Holocene foragers were able to exploit all parts of mainland South-East Asia, it is possible that foods such as yams and taro were also being both exploited and actively tended. Evidence for this has not been found in the archaeological record, but most excavations were conducted before the application of the techniques of parenchyma recovery and starch extraction of the kind used in recent years at Niah. One group of present-day farmers in the interior of Thailand still collects five types of wild yams (J. C. White, 1989). The Batek De' foragers of the central highlands of the Malay peninsula are able to rely on collecting almost twenty species of tubers, especially yams, augmenting this staple food with a wide variety of other plant foods including palm cabbage, palm pith, mushrooms, ferns, bamboo shoots, berries, nuts, seeds, and seasonal fruits, as well as by hunting, fishing, and

practising small-scale horticulture (Endicott and Bellwood, 1991). The list of wild plants and game that they collect, apart from the all-important root crops missing from the archaeological record, is virtually the same as the food species found in the Hoabinhian caves. The diversity of resources in these rain-forests appears to have allowed people in the recent past to subsist by foraging alone, though it is important to note that the Malaysian forest inhabited by the Batek De' has been opened up, and its food diversity thus enriched, by the activities of agriculturalists. Certainly trading with neighbouring farmers for rice, sugar, cooking oil, cloth, metal objects, and flashlights makes life much easier for the Batek De' today than if they were living by foraging alone.

On the marshy coastal lowlands of Thailand, the pollen record has indications of disturbances to the forest almost certainly caused by human activities that could have involved hunting and/or horticultural activities from about 5000 BC (Higham, 1989b; Higham and Maloney, 1989; Maloney *et al.*, 1989). There are clearance episodes marked by the presence of charcoal fragments and increases in grass pollen, including species mostly found today in rice fields. The rice phytoliths found in the same cores from c.6000 BC may belong to wild or domestic plants, but it is noteworthy that their sudden increase in frequency c.5000 BC coincides with the appearance of phytoliths of what are today weedy species in rice fields (Kealhofer and Piperno, 1994). Rice phytoliths are only really abundant, though, after c.2000 BC, coinciding with the first direct evidence for human occupation in this locality, at Khok Phanom Di, occupied c.2000–1500 BC (Higham, 1979; Higham and Bannanurag, 1990; Higham and Thosarat, 2004; Higham *et al.*, 1987, 1992).

The Khok Phanom Di community was sedentary and socially complex. The settlement was associated with a large cemetery, of which just over 150 graves were excavated, providing clear evidence for marked social differentiation with some graves far richer than others and demonstrating people's unequal access to resources such as exotic imports. Most spectacular was a woman buried in a costume with some 120,000 shell-disc beads sewn onto it, various shell necklaces and bracelets, a horned disc of shell, a clay potter's anvil at her feet, and two burnishing pebbles in a shell container. Other people were buried with pots, shell discs, shell bracelets, and ear ornaments. An infant and an adult male were buried with impressive breast ornaments made of turtle shell.

There is abundant evidence for the harvesting of the plentiful wild foods of the nearby swamps, freshwater ponds, river estuaries, and open sea (deer, fish, turtles, crabs, and so on), but coincident with a change to freshwater conditions around the site the community also began to engage in small-scale rice farming on naturally flooded swamp soils. Wear on shell knives shows that they were used for harvesting plants such as rice; pottery contains rice husks (Fig. 6.15); and human coprolites contained rice husks (Fig. 3.5), a species

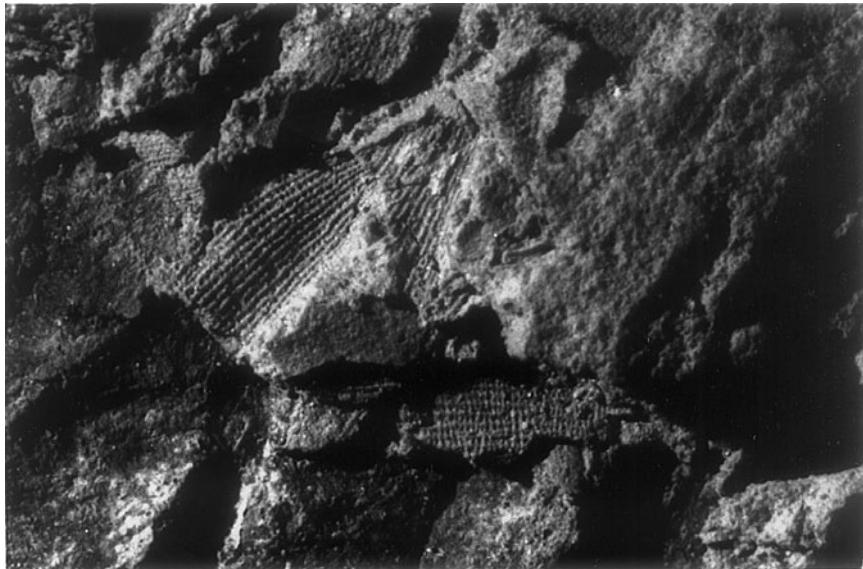


Fig. 6.15. Impressions of rice husks inside a Khok Phanom Di vessel (photograph kindly provided by Gill Thompson)

of beetle adapted to living in stored products such as rice, and mouse hair suggestive of vermin-infested rice stores. The only domestic animal kept was the dog. Khok Phanom Di is one of a series of sites in mainland South-East Asia—other examples are Ban Non Wat, Ban Kao, Ban Chiang, Ban Tha Kae, and Non Pa Wai in Thailand, and Phung Nguyen in Vietnam—characterized by elaborate and socially differentiated inhumation graves (Fig. 6.16), superb pottery, spindle whorls for weaving, domestic rice, domestic dog, and (in some cases) other domestic livestock. Given the lack of evidence for rice farming earlier, Higham (1995, 2002; Glover and Higham, 1996) argues that these sites demonstrate the expansion of Austroasiatic-speaking rice farmers, ultimately from the Yangzi, who interacted with (including intermarrying with) foraging communities such as at Khok Phanom Di. However cultivation was acquired, it had significant effects on Khok Phanom Di society, not just on diet but also on gender roles: analysis of the skeletal material revealed a gradual decline in male upper body development, indicative of less canoeing; changes in tooth wear and disease ensued from the increase in plant foods and the decline in marine foods and shellfish; muscle development in women indicated increasing use of their hands, perhaps as potters. In the light of this evidence and the richness of female as well as male burials, Higham *et al.* (1992) postulated that, as men became less active as fishers and traders over time, the women of the community developed increasing status.

Fig. 6.16. A Neolithic burial from Ban Non Wat, Thailand, dated to about 1800 BC; the burial is of an adult female, who wore cowrie shells as ear ornaments, had three pig skeletons laid over her body, and was accompanied by a series of splendid incised pottery vessels (photograph by the excavator, Charles Higham, and kindly provided by him)



Wet-rice farming was well established in mainland South-East Asia by the mid-second millennium BC, coinciding with the appearance of metal tools and perhaps also with some use of water buffalo. At Ban Chiang, for example, morphologically domestic rice was found together with the bones not only of domestic dogs, cattle, chickens, and pigs, but also domestic water buffalo. The thickened phalanges of the latter suggested that they may have been used for ploughing. However, the first widespread evidence for ploughing, as also of the plough, is much later (Glover and Higham, 1996; Higham, 1995; Higham and Kijngam, 1979, 1985).

TRANSITIONS TO FARMING IN ISLAND SOUTH-EAST ASIA

Today, Austronesian languages are spoken in Vietnam, Taiwan, the Philippines, peninsular Malaysia, Sumatra, Java, Timor, Sulawesi, coastal New Guinea, island Melanesia, much of Remote Oceania, and far to the west in Madagascar. Within the Austronesian language group there is least diversity in the Formosan languages of Taiwan, and most diversity at the other end of the language group in places such as Hawaii and New Zealand (Maori). Following the general approach of Swadesh (1964), some linguists concluded that the Austronesian language group must have developed from an original 'proto-Austronesian' population on Taiwan, with satellite groups budding off, taking their language with them of course, and developing linguistic diversity with time and distance from the homeland (Blust, 1976; Pawley and Green, 1975; Shutler and Marck, 1975). Sites with Neolithic pottery in Taiwan date to about 4000 bc, in the Philippines and Sulawesi to about 3000/2500 bc, in East Timor to 2000 bc. In island Melanesia, sites with Neolithic 'Lapita' pottery date from much the same period (Kirch and Hunt, 1988; Sand *et al.*, 2003; Spriggs, 1989). The linguistic and archaeological evidence has been combined in a demic diffusion model (sometimes referred to as the Express Train model: Diamond, 1988) for the beginnings of farming in the Pacific region, a model expounded in particular by Peter Bellwood (Bellwood, 1988, 1990, 1996b, 1997, 2004; Bellwood and Barnes, 1993; Bellwood *et al.*, 1992; Diamond and Bellwood, 2003; Pawley, 2002). Austronesian-speaking Neolithic colonists from mainland China and Taiwan, the argument runs, spread throughout the Pacific region, taking pottery, rice, and pig farming to the Philippines, Borneo, and Melanesia, and then Lapita pottery, taro, yam, and pig from Melanesia eastwards to Hawaii, New Zealand, and ultimately to Easter Island (Fig. 6.17).

As Bellwood acknowledges, the model is least convincing in the case of New Guinean archaeology (though the proponents of the colonization thesis also point out that most of New Guinea and its archipelago are linguistically separate from the Austronesian language family). Here, foragers' strategies of 'forest manipulation', evident from the time of initial colonization in the Pleistocene, were further developed and intensified through the Holocene, emerging recognizably as formalized agriculture long before the putative Austronesian expansion. Probably the most important contribution to this alternative thesis of an indigenous transition from foraging to farming has been the three decades of fieldwork coordinated by Jack Golson in the Kuk Tea Research Station, at just over 1,500 metres above sea level in the Upper Wahgi valley in the New Guinea Highlands, fieldwork that has since been augmented by a team led by Tim Denham (Bayliss-Smith and Golson, 1992; Denham *et al.*, 2003, 2004a, 2004b; Golson, 1977, 1985, 1989; Golson and Hughes, 1980).

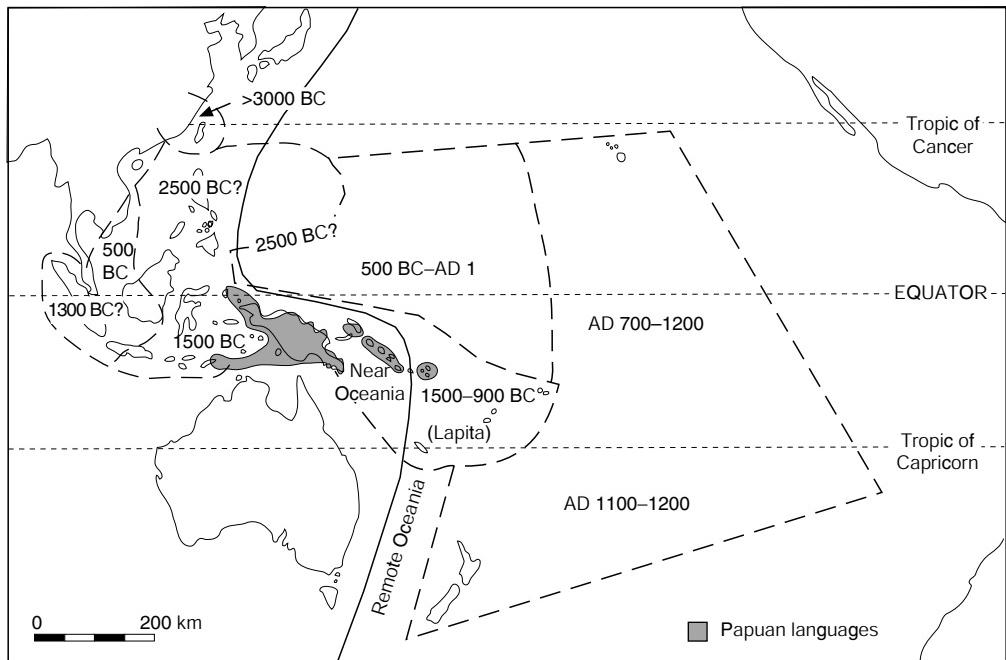


Fig. 6.17. Peter Bellwood's model, with approximate dates, for the expansion of Austronesian-speaking farmers across South-East Asia into the Remote Pacific; the solid line marks his division between Near Oceania and Remote Oceania (after Bellwood, 1997: fig. 4.5, and Pawley, 2002: fig. 20.2)

As elsewhere in New Guinea (and indeed elsewhere in island South-East Asia, as described earlier), the palynological record at Kuk indicates a long record of periodic fire episodes and anthropogenic clearance during the late Pleistocene. The first phase of significant human activity (in terms of archaeological evidence) consists of pits, stake-holes, post-holes, and runnels on slightly elevated levees of a palaeochannel dated to c.8200–7900 cal. bc (Fig. 6.18b). These are interpreted as evidence for shifting cultivation ('the planting, digging and tethering of plants and localized drainage in a cultivated plot': Denham *et al.*, 2003: 190) on wetland margins, perhaps an extension of activities hitherto restricted to drier locations, in the context of a trend to aridity. The deposition of a grey clay at this time is taken to be a sign of accelerated erosion caused by clearance of the surrounding hillslopes. The main crop appears likely to have been taro (*Colocasia esculenta*), from the presence of grains of taro starch on the edges of stone tools associated with this phase. Taro is grown today in wetlands or forest swiddens to avoid pests like the *Papuana* beetle, and its presence in the early Holocene at Kuk is taken as

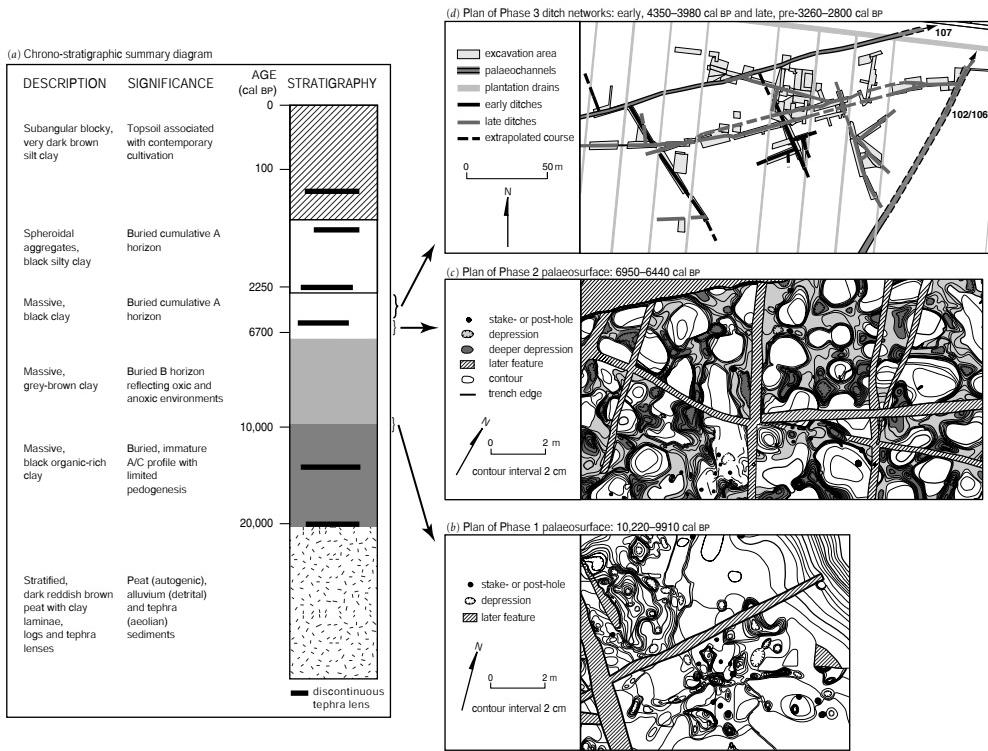


Fig. 6.18. Swamp cultivation at Kuk, New Guinea: the chrono-stratigraphic sequence (a), and the three main phases of prehistoric agriculture (b–d). (Denham *et al.*, 2003: fig. 2; illustration kindly provided by Tim Denham; original field drawings for b and c by Arthur and Cherie Rohn, and for d by Klim Gollan)

evidence for the deliberate movement of this plant into the Highlands. Other possible crops of the same kind include yam, sago, and pandanus.

The principal features of the next phase, on a palaeosurface dated to c.5000–4500 cal. BC, were circular and sub-circular bases of regularly distributed mounds together with numerous post- and stake-holes (Fig. 6.18c, Fig. 6.19). These mounds would have created better-aerated soils along the poorly drained wetland margins and are assumed to be evidence for an increasing commitment to taro cultivation, though unusually high frequencies of phytoliths of banana (*Musa* spp.), a plant that naturally favours wooded and disturbed forest-edge habitats, are also thought to signify its deliberate planting at Kuk at this time. Interestingly, the banana phytoliths include ones likely to derive from the wild Eumusa seeded banana (*Musa acuminata* spp. *Banksii*), that DNA studies suggest was first domesticated in New Guinea



Fig. 6.19. Swamp cultivation at Kuk, New Guinea: 7,000-year-old taro cultivation beds(?) (photograph by Alistair Marshall, kindly provided by Jack Golson)

(Denham *et al.*, 2003: 192). By this phase, there is also extensive evidence in a series of pollen diagrams in and around Kuk for forest clearance, the widespread use of fire, and the establishment and maintenance of disturbed environments (Denham *et al.*, 2004b: 848).

The next phase consisted of a network (some two kilometres in total) of substantial ditches (Fig. 6.18d), dated to c.2350–2000 cal. BC, also presumably for taro and banana cultivation, associated with pollen evidence indicating taro growth on swamp soils and yam cultivation in surrounding hillslope gardens. Single-ended and double-ended paddles like those used today in taro cultivation have been found near Kuk dating to c.2500 BC (Golson and Steensberg, 1985), and from this period, too, agricultural implements such as axes, adzes, and hoes are common in the archaeological record (P. White, 1993).

The final transformations to the landscape were in the mid-second millennium AD: criss-cross ditches, very like the fields of modern farmers in the locality, are assumed to represent the arrival of the sweet potato in the region. The latter was a crop of ultimately South American origin, probably introduced to the island c.AD 800 and again (in what has been termed the Ipomoeaean Revolution) in the context of European colonialism c.AD 1600. Sweet potato could be grown at higher altitudes and in colder conditions than

yams and taro, and allowed dense agricultural populations to develop in the New Guinea Highlands.

The Kuk evidence has been much debated, in terms of its chronology, the significance of its 'indirect' evidence for agriculture, and its suitability as the exemplar of agricultural transitions in New Guinea more generally. In his 1996 review, Bayliss-Smith summarized the major contrasting models for the development of farming on the island as follows: that late Pleistocene foraging was swiftly followed in the terminal Pleistocene or very early Holocene by cultivation (Golson and Hughes, 1980; to which we can add Denham *et al.*, 2003 and 2004b); that foraging in the early Holocene was followed by an intermediate stage of foraging-cum-horticulture c.7000 BC and then by agriculture c.4000 BC (O. Christensen, 1975); that foraging-cum-horticulture was practised from the beginning of the Holocene, with agriculture then developing c.4000 BC (Gorecki, 1986) or c.3000 BC (S. Bulmer, 1974, 1975); and finally, that people lived as foragers for most of the Holocene, only becoming farmers c.1000 BC (Watson and Cole, 1977). However, as Bayliss-Smith concluded, it now seems indisputable that a variety of indigenous plant foods was taken into cultivation by New Guinea Highland foragers very early in the Holocene (Fig. 6.20), long before the assumed Austronesian colonization process. At the beginning of the Holocene (at least), in a further development of the 'forest management' systems of the late Pleistocene (Groube, 1989), people in the New Guinea Highlands were combining hunting with mixed systems of foraging-cum-horticulture targeted at wild plants such as bananas,

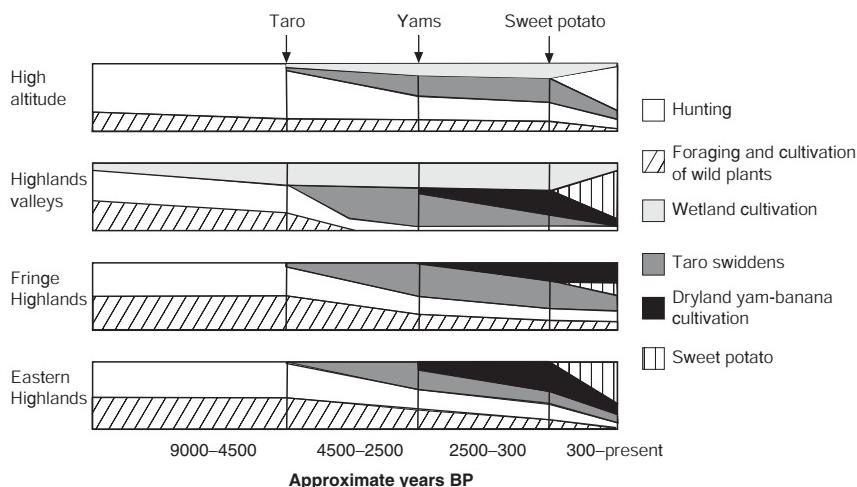


Fig. 6.20. A regional model of agricultural prehistory in the New Guinea Highlands (after Bayliss-Smith, 1996: fig. 26.4)

sugar cane, sago, *Pandanus*, and taro (Yen, 1985). There is also evidence for burning in the lowlands around Lake Hordorli at c.9500 BC (Hope and Tulip, 1994) and for clearance c.5000 BC at Kelela in the Baliem valley (Haberle *et al.*, 1991), suggesting 'a story of sustained and gradually intensifying forest clearance under a regime of shifting cultivation, associated . . . with periodic use of swampland' (Hope and Golson, 1995: 827). The Kuk chronology makes it very difficult to argue that taro cultivation was introduced to the interior peoples of New Guinea c.3000/2000 BC by Austronesian colonists settling the coasts, as Bellwood (1997) proposed. In view of the thousands of years of plant (including taro) management beforehand in New Guinea, local domestication seems the most economic interpretation of the archaeobotanical and botanical data (Denham *et al.*, 2004b; Hather, 1996; Yen, 1995).

The history of pig domestication in New Guinea is less clear. Pigs are thought to be native to South-East Asia but not to New Guinea. The only evidence for fully domestic pigs early in the Holocene is a single pig incisor from Kiowa dated to c.8000 BC that was morphologically very close to those of later domestic pigs (Bulmer, 1974, 1975), but the dating may be insecure. For fully domestic pigs to have reached New Guinea unaided by humans, as this tooth might imply, they would have to have arrived by swimming and 'involuntary rafting' across at least 100 kilometres of ocean, though it is conceivable that people transported wild pigs to New Guinea as a hunting resource in the same manner that they took the cuscus or phalanger to New Ireland in the late Pleistocene. Probably, though, pigs came to the island as an already-husbanded animal, perhaps as early as 6000 BC, but possibly (on the evidence of dates for domestic pigs in the Maluku islands to the west) much later (Bellwood and White, 2005). Golson suggested very tentatively that some of the Kuk depressions within the 'taro fields' might be pig wallows, and so evidence for the keeping of domestic pigs (Golson and Hughes, 1980). Certainly the two could have been managed together rather easily: pigs avoid taro because untreated it is toxic, so they would not have been a threat to taro plots. They may have been managed as in some traditional systems in the recent past, left as semi-feral herds to fend for themselves for much of the year, though it is possible that gardens were fenced off (a significant shift in mindsets between foragers and farmers). With the development of sweet potato farming, though, it would have been essential to fence fields carefully against pigs, and either exterminate pigs or control them in managed herds. In the traditional societies of New Guinea and Melanesia studied by anthropologists in the 1930s and 1940s, most sweet potatoes were in fact used to feed pigs, which were the critical resources for ceremonial feasting and exchange (Brookfield and Hart, 1971; Leahy and Crain, 1937; Rappaport, 1968). Another interesting example of local domestication by New Guinea

Highlanders is the cassowary, a large ostrich-like flightless bird: chicks were often captured and raised tame for gift exchange or consumption at feasts, like pigs (Bulmer, 1967).

Most information about Holocene settlement on the other islands of South-East Asia comes from caves and rock shelters. One of the major trends in their use now was as special places for burying the dead: the West Mouth of Niah Cave, for example, was the location of hundreds of 'Neolithic' graves dated between c.2500 and 500 bc (Barker, 2005, *et al.*, 2002; Harrisson, 1967). However, wherever habitation residues have been identified at such sites, as for example in the case studies of recent fieldwork in peninsular Thailand, Borneo, central Maluku, the Aru Islands, East Timor, and New Ireland described in Barker and Gilbertson (2005; see also D. Anderson, 1997; Latinis, 2000; O'Connor *et al.*, 2002b), they invariably indicate long-lived foraging systems through the Holocene, rather than any sudden commitment to farming associated with the appearance of Neolithic material culture as the Express Train model would predict. Hunting systems in the Holocene geared to conserving animal populations have been proposed from analyses of cuscus remains at Buang Merabak in New Ireland (Leavesley, 2005) and the Brown Dorcopsis wallaby in the Kria and Toé caves in the Bird's Head peninsula of Indonesian Papua (Pasveer, 2003). At Niah, the food refuse left by Neolithic people consists of much the same range of mammals, reptiles, birds, fish, fruits, nuts, and forest tubers as was found in the Pleistocene levels, but the proportion of plant food was increasing in the diet on the evidence of the skeletal chemistry (Krigbaum, 2003). The same trend to plant foods was indicated by use-wear studies of lithics at Ulu Leang I cave in Sulawesi (di Lello, 1998). Parenchyma of forest tubers such as yam and taro have now been found in Holocene foraging contexts at Niah, Madai in Sabah, and Leang Burung 1 in Sulawesi (Paz, 2005). In northern Sumatra, the first systematic clearances c.3000 bc found in pollen diagrams coincide with evidence for the management and conservation of *Canarium* trees for their nuts, oil, and resin (Maloney, 1996). In short, it seems very likely that many Holocene foragers in island South-East Asia were developing forms of 'forest horticulture' akin to those of New Guinea well before the spread of rice.

Secure evidence for the early appearance of domestic rice in the region consists of charred rice remains and rice inclusions in pottery from Gua Sireh cave in western Sarawak, dated to c.2300 bc (Beavitt *et al.*, 1996; Bellwood *et al.*, 1992). A single grain of rice has also been found in the temper of a Neolithic vessel at Niah associated with a burial that has a bone collagen date of c.2500 cal. bc (Doherty *et al.*, 2000), but 'unequivocal cereal grains in all aspects similar to modern rice pollen from local traditional agriculture' in pollen cores taken near the site indicate that rice cultivation may have begun

here by as early as *c.*4000 BC (Hunt and Rushworth, 2005: 467). Convincing amounts of rice remains have been recovered from the Ulu Leang cave in Sulawesi, but there is considerable uncertainty regarding the date of these remains (greater than *c.*4000 BP, and therefore not much younger than the Gua Sireh rice) because of disturbances noted in the stratigraphy (Glover and Higham, 1996). However, recent excavations at this site have found charred rice grains and spikelets in a context dated to *c.*2000 BC (Paz, *pers. comm.*), and rice has also been found at Andarayan in the northern Philippines, dated to *c.*1700 BC (Snow *et al.*, 1986).

Even without the remarkable new evidence for rice cultivation perhaps beginning at Niah before 4000 BC, the dates for the appearance of rice in island South-East Asia are surprisingly early in terms of the Austronesian dispersal model, given that domestic rice is only found in Taiwan and mainland South-East Asia *c.*2000 BC (Bellwood *et al.*, 1992). The implication is that rice cultivation began more or less simultaneously throughout mainland and island South-east Asia, rather than spreading steadily southwards as predicted by the Austronesian-migrants model, a point to which I return at the end of this chapter. Also, rice does not seem to have been widespread as a staple crop in Sarawak, for example, until medieval times, on the evidence of the frequency of rice temper in domestic pottery (Doherty *et al.*, 2000)—until then, the primary crops for most farmers were indigenous crops such as yam, taro, and sago. Ethnographic studies indicate much the same story in the Philippines (Junker, 1996). In both Borneo and the Philippines, in fact, historical and ethnographic records make it clear that many interior societies have combined foraging, plant-tending, and horticulture in different ways, shifting the balance of their activities in response especially to changing relations with coastal agricultural societies (Griffin, 1985; V. T. King, 1993).

TRANSITIONS TO FARMING IN ISLAND MELANESIA AND REMOTE OCEANIA

Lapita pottery is coarsely made with a shell temper, finely decorated with geometric stamps suggestive of bark-cloth and tattooing designs. It has been found at more than a hundred locations on Pacific islands up to 5,000 kilometres apart (Kirch and Hunt, 1988). Somewhat at variance with the predictions of the colonist model, it is rarer in the western sector of its distribution, such as coastal New Guinea, where it also occurs some 2,000 years later than the first pottery, for example at Lachitu and Toara caves near Vanimo (P. White, 1993). Most sites with Lapita pottery date from after 1500 BC. Very few have been excavated, but at Nenumbo on Ngaua in the Solomons there was a series of

simple post-hole structures dating to c.1100 BC, associated with earth ovens, storage pits, domesticated pigs and chickens, fish, shellfish, and birds. The presence at Nenumbo of obsidian, imported from sources in the Bismarck Archipelago 2,000 kilometres away, is testimony to the seafaring prowess of Pacific islanders at this time. Lapita burials in fact confirm that these Pacific islanders had large muscular bodies well adapted to ocean voyaging, whereas people in mainland South-East Asia, Borneo, and New Guinea were better adapted to tropical land masses. This indicator of separate development is a further factor at odds with the Austronesian/Lapita colonization model.

There is also growing evidence for the indigenous development of horticultural practices in island Melanesia and the western sector of Remote Oceania in the pre-Lapita period (Gosden, 1992, 1995; Spriggs, 1993; Terrell and Welsch, 1997; Yen, 1993). In the Bismarck Archipelago, for example, there are indications of erosion caused by horticultural activities in the mid-Holocene, and the domesticated dog, chicken, and pig were all present before the appearance of Lapita pottery (Gosden *et al.*, 1989). Pre-Lapita occupations here at Pamwak, Panakiwuk, and Kilu have produced evidence for *Canarium* seeds and nuts, *Pandanus* nuts, coconut, betel nut, and *Pometia pinnata* (Swadling *et al.*, 1991). By 1500 BC, all the major plants and animals of modern indigenous farming were being grown in the Bismarck Archipelago and the Solomon Islands (Gosden, 1992). Plant remains from Lapita sites in the Mussai islands such as Talepakemalai dating to c.1000 BC include seeds, seed cases, and fruit stones of all the major tree crops of Melanesia today including coconut, breadfruit, Tahitian chestnut, *Canarium*, and *Pandanus* (Kirch, 1989). The first charcoal in Fiji pollen diagrams is dated to c.2500 BC, 1,500 years before major clearances coinciding with the appearance of Lapita sites. There are similar clearance episodes in the Marianas Islands a thousand years before Lapita sites; and 500 years before the first appearance of Lapita pottery on the island of Kosrae in the Eastern Carolinas (which is 500 kilometres from its nearest neighbour), people were cultivating breadfruit, taro, coconut, *Pandanus*, and probably sugar cane (Athens *et al.*, 1996). The indications are of a gradual development of arboriculture and horticulture alongside foraging (especially of marine foods). 'What we are charting is not sudden changes due to the influx of new people, but a series of complex social and subsistence changes taking place over millennia which slowly opened the Pacific to human settlement . . . the region from island Southeast Asia to the end of the Solomons represented a melting pot of different influences' (Gosden, 1992: 57, 61).

The Austronesian/Lapita model predicts that domesticates must have spread across island Melanesia and Remote Oceania from west to east, but though our understanding of the development of agriculture remains greatly

hampered by the lack of direct evidence for taro and yam cultivation, other botanical evidence certainly suggests a much more complex agricultural history (Yen, 1990). Sugar cane, *Australimusa* bananas, and possibly taro all probably originated from New Guinea. The sago palm reached the Philippines and Indonesia from further east. *Canarium* species moved both west and east from New Guinea. Most yams probably moved eastwards, as did pigs, dogs, and chickens. Some yams such as *Dioscorea bulbifera* were indigenous to the entire region, as was the betel nut. In short, much of what Kirch (1984) called the 'transported landscape' thought to be linked to the spread of Lapita pottery was in fact home-grown, with forms of indigenous exploitation developing into patterns of selection and genetic control—in fact, local domestication (Yen, 1985, 1990, 1995). The cline from seed-producing to seedless forms of breadfruit (*Artocarpus altilis*) from western to eastern Polynesia suggests that its domestication was a long-term process, indigenous to the region. Local domestication of various bananas is also likely, and possibly of the coconut too. *Touchardia latifolia* was propagated, tended, and harvested for cordage by Hawaiians at the time of European colonization. Maoris planted swamp flax, *Phormium tenax*. In short, 'the Oceanians retained (or re-invented) the ethnobotanical concepts of domestication throughout their geographical spread and individual paths of development' (Yen, 1985: 324).

Though the data are persuasive that Lapita settlement was preceded by a long period of arboriculture and probably small-scale horticulture, it remains true that the appearance of Lapita pottery usually marks a significant transformation in the archaeological record (A. Smith, 1995; Spriggs, 1996). On the larger islands, its sudden appearance often coincides with the beginning of significant clearance episodes and erosional sediments. Direct botanical evidence for taro and yam cultivation is still extremely limited, but the fact that Lapita pottery is usually accompanied by artefacts such as scrapers and peelers, and constructions such as storage pits and ovens, suggests that on many islands Lapita was associated with the rapid expansion of root and tuber farming, probably also integrated with pig breeding, together with profound social and ideological changes signified by the new material culture. As Terrell and Welsch (1997: 567) comment, in rejecting the thesis that the Lapita complex simply represents new (Austronesian) farmers, Pacific archaeologists need now to focus on establishing how often and how soon wild resources were exhausted, and where in the Pacific and how soon people were obliged to 'act like horticulturalists' (and I would add, to think like horticulturalists as well).

On many Pacific islands the yam-taro-pig mix, in time augmented by the sweet potato, sustained the rapid development of dense and complex societies characterized by craft production and extensive trading networks until

European contact (Gosden, 1992). In Hawaii, the archaeological evidence for the intensive agricultural systems that sustained a series of prehistoric chiefdoms is shown by the construction of fishponds (Kikuchi, 1976) that are contemporary with phytolith evidence for intensified clearance and the creation of terrace fields (Pearsall and Trimble, 1984). Maori gardens in New Zealand have left similar archaeological traces (Bulmer, 1989). Whilst the discovery of carbonized sweet potato tubers in Tangatatau rock shelter on Mangaia in the Cook Islands of eastern Polynesia in levels dating to c.AD 1000 (Hather and Kirch, 1991) confirms the theory that the sweet potato was acquired by Pacific farmers from South America several centuries before European contact, it chimes with the other evidence for the enterprise, innovating spirit, and courage, of these early Pacific voyagers.

ABORIGINAL FARMING IN AUSTRALIA?

And what of Australia, whose prehistoric Aboriginal peoples are traditionally regarded as having been 'bystanders' to the agricultural revolution? Though most Aboriginal foraging societies at the time of European contact appear to have been small-scale and highly mobile, it is clear that there were far denser and more sedentary groups in places with rich food sources such as the central and lower Murray valley (Pardoe, 1988, 1995). These communities had many of the characteristics of similar complex foraging societies, such as those of north-west North America at the time of European colonization and some Mesolithic societies in north-west Europe, including elaborate ceremonial activities, cemeteries, territorial ownership, and inter-group violence. They also practised what can properly be described as effective horticulture (P. White, 2003). Furthermore, particular individuals or groups had proprietary control over the key staple foods, a variety of tuberous roots and rhizomes. The latter were carefully managed: yields were increased by the regular burning of vegetation, and the staple plants were moved to fertile river alluvium, where they were cultivated. The diet of these people was so similar to that of New Guinea agriculturalists that their tooth pathologies are virtually identical (Webb, 1984). The 'horticulture-like' practices of many recent foragers in Australia have already been mentioned (Chapter 2), and whilst Yen (1989) echoes many scholars in his view that these societies were 'domesticating their environment' but were not domesticating plants and animals, some prehistoric/pre-contact Aboriginal groups like those of the Murray valley may have created agro-systems which can be legitimately defined as agriculture (Spriggs, 1996; P. White, 2003), systems which could well go back to the early Holocene (Pardoe, 1995). The fact that they have left so little trace in

the ethnographic record is not surprising: European contact and the diseases that accompanied it destroyed 90 per cent of many Aboriginal societies more or less instantaneously (within a year, sometimes), and the plants that were their staples were either overwhelmed by European farming, especially sheep grazing, or reverted to their natural state.

CONCLUSION

Plant foods were being harvested systematically by late Pleistocene foragers throughout East and South-East Asia, including wild millet in northern China, wild rice in southern China and mainland South-East Asia, and swamp taro, *Pandanus*, and sago in island South-East Asia and island Melanesia. The foragers who colonized island South-East Asia c.45,000 years ago knew how to process potentially toxic plant foods collected from the rainforest. Almost certainly they burnt the forest to enhance plant growth, a form of forest management that in some respects was a forerunner of the *molong* systems of plant stewardship and protection practised by Penan foragers in Borneo today. Some of these Pleistocene foragers went even further to enhance the range and reliability of their food supplies, the most remarkable example being the deliberate transport of the cuscus from New Guinea to New Ireland, involving a substantial sea-crossing.

In China, as in South-West Asia, the climatic changes at the beginning of the Holocene caused significant shifts in vegetation belts, and thus in the density and distribution of plant foods. They allowed rice to extend its range into the Yangzi valley, and millet to flourish in the middle and lower Huanghe valley. CO₂ changes may also have made both of these seed plants more valuable as food sources. Within about a millennium of the start of the Holocene, millet and rice were being harvested much more intensively than before, and technologies had been developed for growing, processing, and storing the harvest. Pigs may also have been taken increasingly under control, perhaps in part to protect the millet and rice crops, though the main sources of meat remained game, shellfish, and fish. Dogs were certainly domesticated by now. By c.7500 BC people in the middle and lower Yangzi valley were probably relying on rice as their staple food, but they practised little animal husbandry and still foraged extensively. By c.6500 BC millet was the staple crop for comparable sedentary societies in the middle and lower Huanghe valley, where horticulture was integrated with animal husbandry, particularly of pigs, but as in the Yangzi the diet was augmented by foraging. By the later sixth millennium BC, integrated systems of mixed farming sustained substantial village communities, who in the Yangzi may have practised wet-rice cultivation.

In Korea, Japan, and mainland South-East Asia, though, people remained primarily as foragers through the early Holocene. Access to rich marine resources, combined with storage technologies, including pottery, allowed many coastal communities in Japan to become increasingly sedentary. (The same was probably true of mainland South-East Asia, but the Holocene flooding of the Sunda Shelf has removed the evidence.) The acquisition of exotic plants such as bottle gourd and buckwheat by Japanese foragers, and the exotic materials used for grave-goods at sites such as Khok Phanom Di, are evidence of the extensive (including maritime) exchange systems in which these sedentary, socially complex, communities participated. By the mid-Holocene, though, their foraging systems were being combined with horticulture-like activities, in most instances in what appear to have been gradual processes of internally driven subsistence change (though in some cases involving more rapid instances of forager-farmer interaction as Higham argues in the case of Khok Phanom Di). Clearances were created in forests to enhance grazing for game, and plants valued for human consumption were also tended, including rice and probably taro and yam in mainland South-East Asia, millet and rice in Korea, and buckwheat, green grams, the beefsteak plant, rice, and the millets in Japan. In all three regions, the mix of foraging and small-scale horticulture was followed by a sudden and dramatic shift to intensive mixed farming, especially wet-rice farming using paddy fields, water buffalo, and metal tools. The shift seems to have been both sudden and widespread (in the mid-second millennium BC in Korea and mainland South-East Asia, in the later first millennium BC in Japan), in each case associated with the emergence of complex stratified societies and a quantum increase in population densities marking the beginnings of political centralization and state formation. These developments have traditionally been interpreted in terms of the influx of new people, but now seem more likely to have been the result of interrelated processes of social intensification amongst the indigenous populations.

The 'Express Train' model of Austronesian-speaking farmers sailing southwards from mainland China across the Pacific with their rice and pigs certainly has the virtue of simplicity, but as will be clear from the preceding discussions I believe that transitions to farming in this vast region have to be understood primarily in terms of local trajectories of subsistence change. Forms of arboriculture and probably horticulture were being practised well before the expansion of rice, at least in the early Holocene and quite possibly earlier still. The central and eastern Pacific was a 'melting pot' of local domestications and cultigen acquisition from both west and east, not a one-way movement of agricultural colonists. Early DNA studies were thought to support the Austronesian dispersal model (Hagelberg, 1997; Hagelberg and Clegg, 1993), but the patterns of genetic diversity in the present-day populations of the

region are now thought to reflect a complex sequence and a long history (beginning in the Pleistocene) of splits and mixings, of east–west as well as west–east movements (Oppenheimer and Richards, 2001*a*, 2001*b*), patterning (or rather, a lack of simple patterning) that chimes well with the complexity of the archaeological evidence.

After millennia of forest management and a variety of forms of horticulture (and possibly animal husbandry), the ‘rice-pig’ system spread incredibly quickly throughout South-East Asia probably in the centuries on either side of 2000 bc, even though for many of these societies rice may not have been a staple food until much later (Doherty *et al.*, 2000). If the dramatic spread of these new resources can no longer be explained satisfactorily in terms of Austronesian farmer-colonists, their rapid uptake by South-East Asian populations of forager-horticulturalists could well be a good example of Hayden’s theory (1990, 2003) that many domesticates may have been acquired first by foragers because they valued them as luxury foods and/or prestige goods, rather than as the dietary staples that they became in time, and as they remain today.

Weed, Tuber, and Maize Farming in the Americas

INTRODUCTION

The American continent extends over 12,000 kilometres from Alaska to Cape Horn, and encompasses an enormous variety of environments from arctic to tropical. For the purposes of this discussion, such a huge variety has to be simplified into a few major geographical units within the three regions of North, Central, and South America (Fig. 7.1). Large tracts of Alaska and modern Canada north of the 58th parallel consist of tundra, which extends further south down the eastern coast of Labrador. To the south, boreal coniferous forests stretch eastwards from Lake Winnipeg and the Red River past the Great Lakes to the Atlantic, and westwards from the slopes of the Rockies to the Pacific. The vast prairies in between extend southwards through the central United States between the Mississippi valley and the Rockies, becoming less forested and more open as aridity increases further south. South of the Great Lakes the Appalachian mountains dominate the eastern United States, making a temperate landscape of parallel ranges and fertile valleys, with sub-tropical environments developing in the south-east. The two together are commonly referred to as the ‘eastern Woodlands’ in the archaeological literature. On the Pacific side are more mountain ranges such as the Sierra Nevada, separated from the Rockies by arid basins including the infamous Death Valley.

These drylands extend southwards into the northern part of Central America, to what is now northern Mexico, a region of pronounced winter and summer seasonality in temperature, with dryland geology and geomorphology and xerophytic vegetation. The highlands of Central America, from Mexico to Nicaragua, are cool tropical environments with mixed deciduous and coniferous forests. The latter develop into oak-laurel-myrtle rainforest further south in Costa Rica and Panama. The lowlands on either side sustain a variety of tropical vegetation adapted to high temperatures and frost-free climates, including rainforest, deciduous woodland, savannah, and scrub.



South America can be divided into a number of major environmental zones (Pearsall, 1992). The first is the Pacific littoral, which changes dramatically from tropical forest in Colombia and Ecuador to desert from northern Peru to central Chile. This coastal plain is transected by rivers flowing from the Andes, and in places patches of seasonal vegetation (*lomas*) are able to survive in rainless desert sustained by sea fog. The Andean chain has a complex topography, but broadly increases in height with increasing distance south. There are deep valleys in the north-west, in Colombia (the Cauca and Magdalena valleys), whereas topography is much more dissected further south, a feature of the central and southern Andes being high rolling grasslands (*paramo* or *puna*). The Amazon and Orinoco lowlands, from the eastern slopes of the Andes (*montaña*) to the Atlantic, are dominated by dense tropical rainforest cut by broad meandering rivers. There are ancient uplands to the north and south of the Amazon basin, the Guiana and Brazilian highlands respectively, regions of thinner soils and more open forest. East of the Andes further south are extensive grasslands, seasonally inundated *llanos* to the north and drier *pampas* further south.

At the time of European contact, indigenous American farmers were probably cultivating more than a hundred species of plants (Piperno and Pearsall, 1998). The primary crop for most farmers was maize (*Zea mays*), the cultivation of which was the economic foundation of the Aztec empire in Central America, the Inca empire of the north-western part of South America, the chiefdom societies that characterized much of the eastern part of North America, and numerous smaller-scale societies elsewhere. Maize cultivation

Fig. 7.1. The Americas, showing the principal regions and sites mentioned in Chapter 7.
Sites: 1. Bluefish Caves; 2. Nenana valley; 3. Scowitz; 4. Head-Smashed-In; 5. Vail; 6. Passamaquoddy Bay; 7. L'Anse Amour; 8. Scottsbluff; 9. Schultz; 10. Princess Point; 11. Kipp Island, Hunter's Home; 12. Wickham; 13. Merrimack River; 14. Turner Farm site; 15. Three Fir shelter; 16. Mesa Verde; 17. Olsen-Chubbuck site; 18. Chaco Canyon—Pueblo Bonito, Sheep Camp Shelter; 19. Zuni; 20. Bat Cave; 21. Tucson basin—Fairbank, Milagro; 22. Tornillo rock shelter; 23. Folsom; 24. Clovis; 25. Lipscomb; 26. Ozark rock shelters—Cob Cave, Cow Ford, Marble, White Bluff; 27. American Bottom, Modoc rock shelter; 28. Koster, Napolean Hollow; 29. Dickson Mounds; 30. Bowles, Carlston Annis; 31. Mammoth Cave, Salts Cave; 32. Moundville; 33. Icehouse Bottom; 34. Cloudsplitter, Newt Kash caves; 35. Edwin Harness mound; 36. Meadowcroft rockshelter; 37. Cactus Hill; 38. Bakers Cave; 39. Windover; 40. Balsas river valley; 41. Tehuacán valley; 42. San José Mogote, Oaxaca; 43. Chichen Itza; 44. Coba; 45. Calakmul; 46. Lake Penet Itza; 47. Tikal; 48. Cuello; 49. Cobweb Swamp, Colha; 50. Mazatán; 51. Los Tapiales; 52. Copan and Lake Petapilla; 53. Arenal; 54. Turiyalba; 55. Lake La Yeguada, Corona; 56. Proyecto Santa María sites—Aguadulce, Corona, Carabalí, Cerro Mangote, La Mula, Mongranillo; 57. Madden Lake; 58. Río Pedregal; 59. El Cayude; 60. Taima-Taima; 61. Las Varas; 62. Guayana; 63. Banwari Trace, St John; 64. Magdalena valley—Negra I, Paramó de Peña Negra; 65. Gaván, Rio Canaguá; 66. Cauca valley—El Recreo, Lusitania, Sauzalito; 67. El Abra, Tibító; 68. San Isidro; 69. La Elvira; 70. Araracuara, Abeja, Peña Roja; 71. Manaus; 72. Caverna da Pedra Pintada, Lake Geral, Monte Alegre, Taperinha; 73. Pedra Furada; 74. Santa Elena, Real Alto; 75. Lake Ay auch; 76. La Emerenciana; 77. Zafí valley; 78. Huaca Prieta; 79. La Galgada; 80. Guitarrero cave; 81. Pampa de las Llamas-Moxeke, Casma valley; 82. Caral; 83. Lake Junín, Panalaucá, Telemachay; 84. Las Haldas; 85. El Paraiso; 86. Chilca, Paloma; 87. Ayacucho; 88. Cuzco; 89. Lake Titicaca; 90. Atacama desert—Puripica, Tulán; 91. Monte Verde; 92. Estannia los Toldos

was integrated with a wide variety of other crops, depending on local growing conditions. Commonest were pulses such as beans (the common bean *Phaseolus vulgaris*; the jack bean *Canavalia ensiformis*; the Lima bean *Phaseolus lunatus*) and the peanut (*Arachis hypogaea*). Cultivated squashes included the pepo or pumpkin (*Cucurbita pepo*), the butternut squash (*Cucurbita moschata*), the silverseed gourd or cushaw (*Cucurbita argyrosperma*), the warty squash (*Cucurbita maxima*), and the Malabar gourd (*Cucurbita ficifolia*). The potato (*Solanum tuberosum*) and quinoa (*Chenopodium* sp.) were important staples in the high Andes. In more tropical regions, agricultural systems also included the cultivation of roots and tubers such as yams (*Dioscorea trifida*), cocoyams (*Xanthosoma sagittifolium*), manioc (also called cassava or yuca: *Manihot esculenta*), the sweet potato (*Ipomoea batatas*), and a very wide variety of tree crops such as avocado (*Persea americana*), cashew (*Anacardium occidentale*), peach palm (*Bactris gasipaes*), pineapple (*Ananas comosus*), papaya (*Carica papaya*), and guava (*Psidium guajava*). Four species of chilli peppers, the ferociously hot *ají* that underpins Mexican and South American cuisine today, were grown: *Capsicum annuum*, *C. frutescens*, *C. baccatum*, and *C. pubescens*. Plants cultivated for industrial purposes included cotton (*Gossypium barbadense* and *Gossypium hirsutum*) and the bottle gourd (*Lagenaria siceraria*), the latter for use as a container.

For most of these American farmers, the only important domestic animal was the dog. The main stock animals, llama and alpaca, were restricted to the Andes, as was the guinea pig, the latter kept by many subsistence farmers then as today as a useful source of meat. Phylogenetic studies indicate the hybrid nature of the llama and alpaca, and considerable genetic distinctiveness between these and the two wild camelids, the vicuña and guanaco (Stanley *et al.*, 1998), but genetic evidence suggests that the alpaca is descended from the vicuña (Kadwell *et al.*, 2001). Both the llama (*Lama glama*) and alpaca (*Lama pacos*) are good sources of meat, which can be dried and salted as *charki* (Browman, 1989), and their dung can be used as fuel or fertilizer. Whilst the coarse wool of the llama can be used for blankets, rugs, and cordage, the animal is particularly valuable as a beast of burden, able to carry loads of 20–40 kilograms up to 30 kilometres a day (McGreevy, 1989). The llama was a critical military resource for the Incas, and the llama herds of conquered peoples were carefully controlled (Brotherston, 1989). The alpaca produces much finer wool than the llama, but does not carry loads, and also needs better grazing and more watering than the llama. Today most llamas are kept by farmer-herders in mixed systems of agro-pastoralism in the better-watered parts of the Andes, but there are also specialized pastoralists in areas of dry upland pasture. Transhumant grazing systems are common, in which llama herds are driven between higher and lower pastures on a seasonal basis. The herding

systems practised at the highest altitudes are more akin to the herd-following practised by modern reindeer herders in Greenland (Chapter 2, p. 68), with the pregnant females being taken under control but the rest of the herd left to move of its own accord (Rabey, 1989).

Many of the indigenous societies encountered by Europeans combined plant husbandry with foraging, whilst large tracts of the Americas were occupied by people who lived mainly or wholly as foragers. The rich marine resources of coastal North America, particularly the Pacific coasts of what is now Washington DC and British Columbia, sustained particularly populous communities, many of them in more or less permanently occupied villages and in societies characterized by similar levels of political complexity to those of the chiefdom agricultural societies of the eastern United States. After the Spanish conquest of Central America, the acquisition of the horse by North American foragers also stimulated the development of a complex foraging culture on the vast prairies between the Mississippi and the Rockies, based largely on the specialized exploitation of the buffalo.

THE FIRST INHABITANTS

For decades the dominant theory for the initial colonization of the Americas has been that people walked over the Bering Strait land-bridge that linked Siberia to Alaska in the late Pleistocene (Catto, 1996; West, 1996). The land bridge, together with the corridor between the Laurentide and Cordilleran ice-sheets giving access to the main continent, would have been open before about 30,000 years ago, closed during the Last Glacial Maximum, and open again by about 15,000 years ago. The first clear evidence for human occupation in Alaska and the Yukon, of people hunting mammoth, bison, wapiti (*Cervus canadensis*), steppe bison (*Bison priscus*), and caribou or reindeer, dates to the latter period (Cinq-Mars, 1990; Powers and Hoffecker, 1989). However, given what we now know of the seagoing technologies of Pleistocene foragers in South-East Asia, it is also possible that people from the Eurasian continent reached America at an earlier (much earlier?) date by island-hopping to the Pacific coast from Japan and Siberia, and/or by sailing along the edge of the northern glaciers from western Europe via Greenland to the eastern seaboard (Gruhn, 1994; T. Jones *et al.*, 2002; Parfit, 2000); and indeed 40,000-year-old 'human' footprints have been reported recently, preserved in volcanic ash near Mexico City (Keys, 2005), though their human assignation is disputed.

In 1986 Greenberg *et al.* concluded from a study of linguistic, dental, and genetic evidence that there were three major linguistic families, each of which had entered the Americas as a separate migrating group: Eskimo-Aleut, in

the far north; Na-Dene, spoken in parts of North America; and Amerind, a vast family containing all the other languages of North, Central, and South America. Using the techniques of glottochronology, they estimated the entry times as, respectively, before 11,000 years ago for Amerind, 9,000 years ago for Na-Dene, and 4,000 years ago for Eskimo-Aleut. More recently, linguistic estimates for dates of first entry (based on calculations of the time necessary to result in the present-day diversity of the indigenous languages) have varied from the end of the Pleistocene to far earlier, say 35,000 years ago (Nichols, 1990). Recent genetic studies have emphasized the similarity of indigenous American populations to one another and their difference from the rest of the world, and (depending in particular on how rates of genetic mutation are estimated) have placed the first migrations into America variously between c.30,000 years ago and the end of the Pleistocene (Bonatto and Salzano, 1997; Horai *et al.*, 1993; Torroni, 2000, *et al.*, 1994). Of course it is quite possible that there was a series of small-scale early migrations that came to grief before sustainable human settlement was established.

Apart from some stone tools at Cactus Hill in Virginia that may be 18,000 years old (Parfit, 2000), the main archaeological evidence for human occupation begins about 15,000 years ago (Dillehay, 2000; Haynes, 2002; Meltzer, 1993). The evidence for early settlement is extremely contentious, bedevilled by stratigraphic and dating uncertainties (T. F. Lynch, 1990), and several putative early sites such as Guittarero cave (T. F. Lynch, 1980; Lynch and Kennedy, 1970) and Pikamachay cave in the Ayacucho basin (MacNeish, 1977) in Peru are now realized to have been disturbed, palynological evidence indicating that their occupations are clearly Holocene. However, there is now convincing evidence that in the millennia following the Last Glacial Maximum there were foragers not just in central North America (the Meadowcroft rock shelter near Pittsburgh: Adovasio *et al.*, 1980), but probably also in the highlands of Mexico (the Coxcotlan phase in the Tehuacán valley: Byers, 1967), the lowland grasslands of Venezuela (Taima-Taima: Gruhn and Bryan, 1984), the high *paramo* on the eastern slopes of the Andes in Colombia (El Abra: Correal Urrego, 1986; Tibitó: Correal Urrego, 1981), the Chilean coast (Monte Verde: Dillehay, 1989), the Amazon basin (the Caverna di Pedra Pintada at Monte Alegre: Roosevelt *et al.*, 1996), the Brazilian highlands (Pedra Furada: Guidon, 1984), and the *pampas* (Politis *et al.*, 1995). People seem to have spread throughout the continent with breathtaking speed after the LGM, for one of the most secure sites, Monte Verde in Chile, has dates of almost 15,000 years ago and is 10,000 kilometres from Alaska.

By the end of the Pleistocene, effective foraging strategies had enabled the expansion of settlement across much of the American continent. Hunting systems predominated in North America, using tool kits that included specialized grooved projectile points named after the sites of Clovis and Folsom

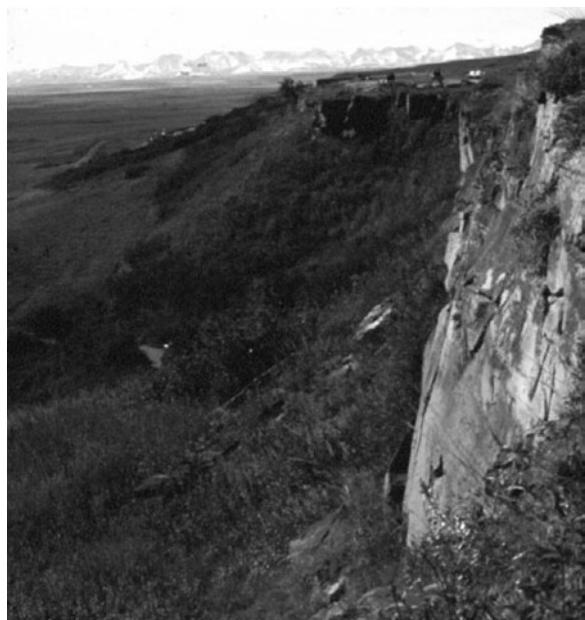


Fig. 7.2. Palaeoindian bison kill-sites on the North American plains: (*above*) the cliffs at the Head-Smashed-In site near Calgary, Canada, over which bison were stampeded; (*below*) butchered bones of bison stampeded into a narrow ravine at the Olsen-Chubbs site, Colorado, USA (photographs kindly provided by, respectively, Brian Kooyman and the University of Colorado Natural History Museum)



in New Mexico (Haynes, 1993; Meltzer, 1988). In the northern tundras and boreal forests, hunters specialized on migratory herbivores such as caribou, moose, and red deer, camping especially at ambush locations on migration routes such as Vail by Lake Aziscohos in western Maine (Gramly, 1981, 1984). On the plains, the principal prey was *Bison antiquus*, an animal 50 per cent larger than the modern bison, which probably wintered in the foothills of the Rockies and migrated out onto the plains in the spring and summer. Typical sites such as Scottsbluff (Nebraska) and Lipscomb (Texas) appear to consist of short occupations where herds were ambushed (Todd *et al.*, 1990; Fig. 7.2). Studies of the sources of stone used by these prairie hunters indicate that they operated within huge annual territories, migrating enormous distances tracking the movements of the bison herds (Amick, 1996; Kelly and Todd, 1988). Dog teeth marks on bones suggest that domestic dogs were used to help with the game drives, and it is possible that they were also trained to pull travois like the dogs of some later Plains Indian societies (Fiedel, 2005). In the more forested regions of eastern North America, people practised more generalized foraging systems involving plant gathering as well as hunting (Dent and Kaufman, 1985). This also seems to have been the case in northern Mexico. Coxcotlan foragers in the Tehuacán valley hunted larger animals like antelopes and horses, but mostly killed small game such as rabbits (communal rabbit drives have been suggested) and collected fruits including the prickly pear and mesquite (Byers, 1967; MacNeish, 1962).

In the cooler and drier conditions of the late Pleistocene, the tropical lowlands of Central and South America that now support rainforest had a mixed vegetation including drier lowland species and also species now found in cooler uplands above 1,500 metres above sea level (Piperno and Jones, 2003; Piperno and Pearsall, 1998; Figs. 7.3 and 7.4). Areas that are seasonal tropical forest today carried a mixture of thorn woodland, scrub, and savannah. The people camping in the Caverna di Pedra Pintada were able to exploit this variety of habitats (Roosevelt *et al.*, 1996). They hunted large and medium-sized mammals (a late Pleistocene mastodon, a giant ground sloth, giant peccaries, an armadillo-like animal, and llama), smaller animals such as turtles, tortoises, rodents, and snakes, as well as birds. They fished, collected shellfish, and gathered plant foods such as tree fruits and nuts: the evidence for the latter included palms and brazil nuts, but the open parts of the landscape would also have provided maguey (*Agave*), cacti, prickly pear (*Opuntia*), mesquite (*Prosopis juliflora*), and various legumes (Piperno and Pearsall, 1998). The difficulties of living in tropical rainforest by foraging alone have been rightly emphasized (R. C. Bailey and Headland, 1991), but as in South-East Asia it is clear that foragers were able to colonize tropical Central and South America in the late Pleistocene in part because these regions were more diverse ecologically than today, allowing them to exploit a wide range of food sources.

The presence of charcoal, together with pollen and phytolith indicators of clearance, in silts dated to c.11,000 BP in Lake La Yeguada in Panama (Bush *et al.*, 1992) also chimes with the South-East Asian evidence that, by the end of the Pleistocene, foragers encountering tropical environments were developing strategies for enhancing their food potential, for example by creating disturbed environments that would have favoured grazing animals and plants such as roots and tubers (Fig. 7.12). Presumably the ability to deal with the toxicity of many of the latter by practices such as leaching was learned at a very early stage (Johns, 1989). Furthermore, 'when humans entered the tropical forest and fired and cleared the vegetation, they unconsciously increased the reproductive fitness of many wild plants and animals most beneficial in their diets, and set the stage for the reproduction of these plants through cultivation and domestication' (Piperno and Pearsall, 1998: 76).

FORAGING AND FLOODPLAIN WEED CULTIVATION IN EASTERN NORTH AMERICA

With the transition to the warmer and wetter climate of the Holocene, the northern ice-sheets and their adjacent tundras contracted, the southern limit of boreal forest moved northwards, and temperate woodlands were widely established across much of North America, though of course the density of woodland varied greatly with relief. In a landscape of woods and glades, lakes and rivers, broad-based systems of foraging were developed by the indigenous 'Archaic' populations of North America (Neusius, 1986) that were somewhat akin to those of contemporary Mesolithic societies in Europe (Chapter 9). One of the main animals hunted in the deciduous forest zone was the white-tailed deer (*Odocoileus virginianus*). In the Mississippi valley most Archaic sites seem to be small ephemeral or short-season camps—the Modoc shelter is something of an exception (Phillips and Brown, 1983; Styles *et al.*, 1983). Summer camps on river terraces or levees are generally larger than winter camps in upland areas, but the limited use of rock-shelters and the ephemeral archaeology of most sites, including little or no evidence for storage, indicates that most early Archaic foraging bands were highly mobile, moving rapidly from resource to resource in a single residential group rather than using longer-term fixed camps for the main group supported by networks of smaller foraging stations (Kelly and Todd, 1988; P. J. Watson and Kennedy, 1991).

From the outset, the diet probably included a wide variety of forest plant foods—acorns and hickory nuts were the staple foods collected at Icehouse Bottom on the Little Tennessee River, for example (J. Chapman, 1985)—and also the seeds of plants growing in flood-disturbed open habitats by rivers. The latter included the oil-rich marsh elder or sumpweed (*Iva annua*) and

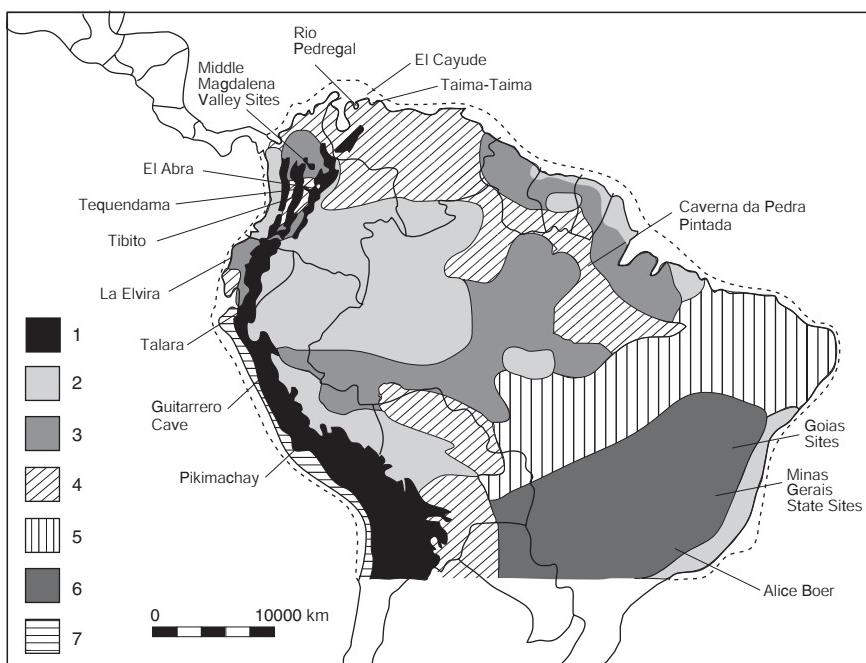
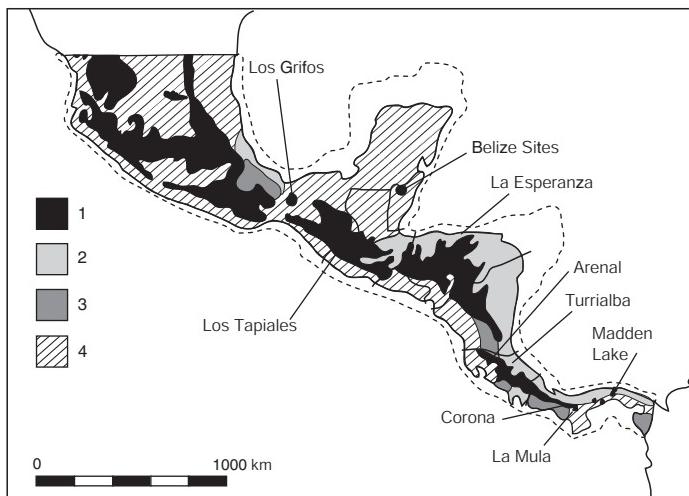


Fig. 7.3. Palaeoindian sites in (above) Central and (below) South America, plotted against late Pleistocene reconstructed vegetation; dashed line indicates sea-level lowering. 1. monatane forest; 2. unbroken moist forest; 3. drier forest than today; 4. thorn woodland, scrub, and savannah; 5. dry savannah with *cerrado* and *caatinga* taxa; 6. open and fairly humid; 7. desert/cactus scrub (after Piperno and Pearsall, 1998: fig. 4.1)

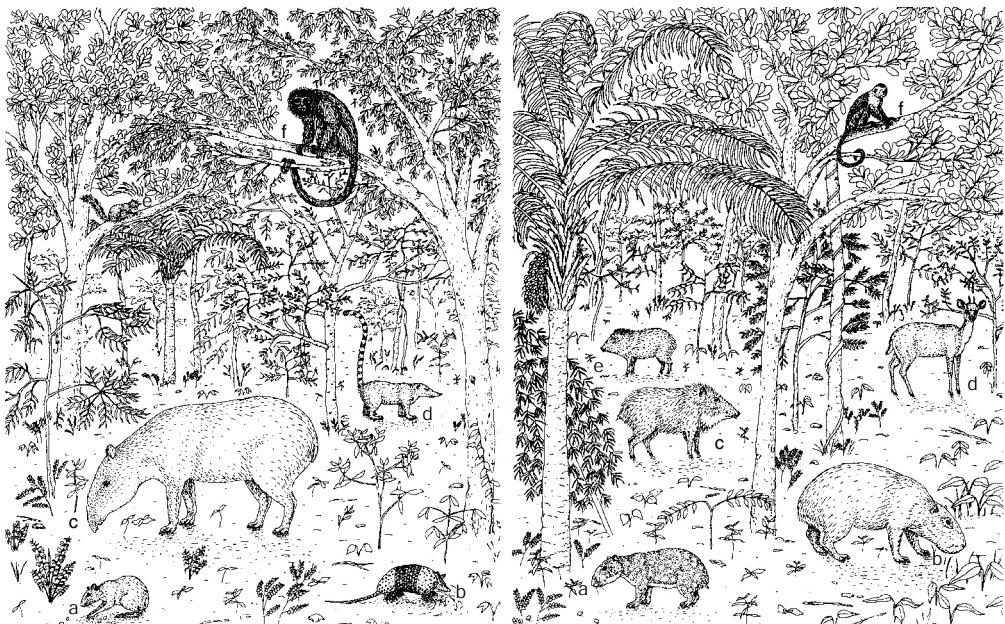


Fig. 7.4. Some of the game animals of American tropical forests hunted by Palaeoindians: (left) (a) agouti (*Dasyprocta punctata*); (b) nine-banded armadillo (*Dasypus novemcinctus*); (c) tapir (*Tapirus bairdii*); (d) coati (*Nasua nasua*); (e) squirrel (*Sciurus granatensis*); (f) howler monkey (*Alouatta palliata*); (right) (a) paca (*Agouti paca*); (b) capybara (*Hydrochaeris hydrochaeris*), the world's largest rodent; (c) white-lipped peccary (*Tayassu peccari*); (d) brocket deer (*Mazama americana*); (e) collared peccary (*Tayassu tajacu*); (f) white-faced monkey (*Cebus capucinus*) (Piperno and Pearsall, 1998: fig. 2.3; illustration kindly provided by Dorothy Piperno and Deborah Pearsall)

sunflower (*Helianthus annuus*), the carbohydrate-rich goosefoot (*Chenopodium berlandieri*), knotweed (*Polygonum erectum*), little barley (*Hordeum pusillum*), and maygrass (*Phalaris caroliniana*), as well as squashes such as *Cucurbita pepo* (B. D. Smith, 1995a, 1995b). The wide variety of edible plants is presumably one of the main factors explaining the larger size of the summer riverside camps.

Denser populations rapidly developed on the northern Atlantic and Pacific coasts, where people were able to combine the kind of 'forest economy' practised by the inland foragers with the exploitation of the diverse and abundant maritime fauna. At L'Anse Amour and Port au Choix in Newfoundland, for example, Archaic foragers hunted caribou and trapped beaver inland, but the main focus of subsistence was hunting walrus, seal, and even whale, presumably using seagoing kayaks (Speiss, 1993; Tuck, 1976). Despite the diversity of resources exploited, the nature of the settlements—clusters of simple shelters

dug into beaches—and the evidence of their seasonal occupation suggest that the northern coastal foraging populations of the early Holocene were probably as mobile as those inland. On the arid Gulf of Mexico coast, early Archaic foragers seem to have been low-density and highly mobile, hunting some deer but mainly a variety of smaller mammals such as hares, rabbits, and rodents, and gathering a wide variety of nuts, berries, and seeds: prickly pear, walnut, persimmon, mesquite, onion, yucca, grape, hackberry, goosefoot, amaranthus, and so on (Story, 1985).

It used to be thought that most people in North America remained foragers for thousands of years, eventually acquiring maize, squash, and beans, and learning the associated skills of cultivation, as late as c.AD 1000. There is convincing evidence now, however, that long before this date many Archaic foragers learned to cultivate plants early in the Holocene, in what has been termed by Bruce Smith the ‘floodplain weed theory’ (Smith, 1987, 1989, 1992a, 1992b, 1995a, 1995b). In the floodplains of the Mississippi valley, for example, three weeds in particular, marsh elder, goosefoot, and pepo squash, would have been relatively abundant, and were presumably harvested at the end of summer by early Archaic foragers. Some plants could have seeded themselves on settlement middens, but given the high degree of mobility, with people rarely returning to the same place and then for only brief periods, the returning forest would soon have closed down such humanly created open habitats.

From about 5000 BC, however, a climatic trend to aridity caused rivers to stabilize and aggrade (Styles, 1986), increasing the number and stability of features such as meanders, oxbow lakes, lagoons, bars, and shoals. These changes would have increased the range, diversity, and predictability of aquatic foods (fish, shellfish, and crustaceans), waterfowl, and also the plants growing in open, disturbed, habitats. In fact, faunal residues show that fish, shellfish, and crustaceans made an increasingly important contribution to the diet (Styles, 1986). There are many indications that people started increasingly to concentrate settlement along watercourses, camping there from spring to autumn and returning to the same locations year by year (J. A. Brown and Vierra, 1983). Smith argues that these changing settlement trends must have changed the riverside ecologies by creating continually disturbed open habitats that allowed the floodplain weeds to establish themselves as permanent components of the plant communities. This provided the context for a significant intensification in plant exploitation that Smith characterizes as ‘a stress-free opportunistic undertaking that occurred in a context of relative subsistence abundance and security’ (Smith, 1995b: 212).

The first clear evidence for cultivated plants in North America is rind fragments of pepo squash from Koster (Illinois) that have been AMS-dated to c.5000 BC (Asch and Asch, 1985; Fig. 7.5), and fragments of bottle gourd from

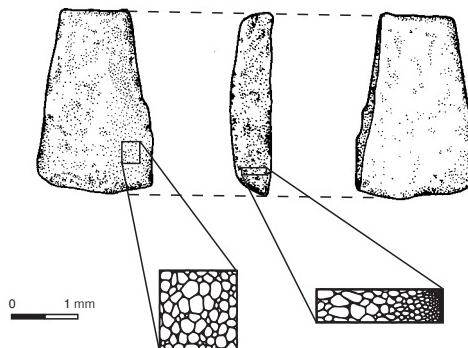


Fig. 7.5. Rind fragment of squash from Koster, Illinois, c.5000 BC: the inner surface (left), cross-section (centre), and outer surface (right) (after Asch and Asch 1985: fig. 6.2)

Windover in Florida (Doran, 2002; Doran *et al.*, 1990) of similar antiquity. From about c.3000 BC, however, there is a clear trend to larger seeds of marsh elder and sunflower indicative of increased reserves for rapid spring growth, squashes have thicker rinds, and chenopods develop thinner seed coats presumably in response to the reduced dormancy requirements of humanly planted seeds (Figs. 7.6, 7.7). The reasonable assumption is that people must

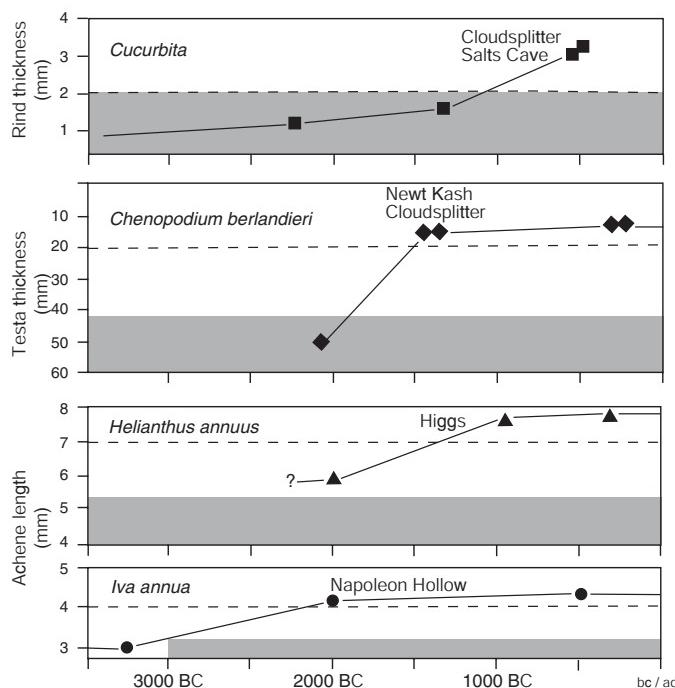
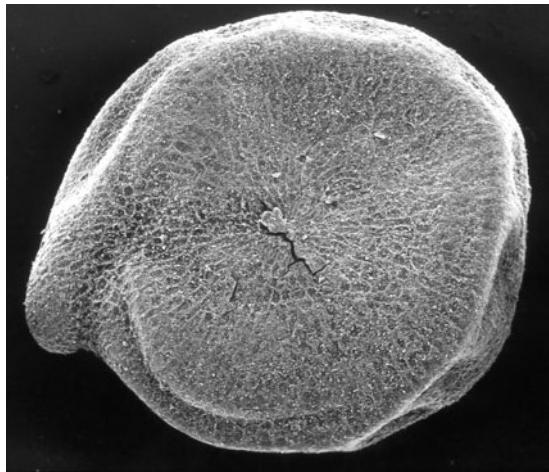


Fig. 7.6. The domestication of indigenous crop plants in eastern North America, based on morphological changes; shaded area: modern undomesticated size ranges; dashed line: baseline for domestication (after B. D. Smith, 1989: fig. 2)

Fig. 7.7. Scanning electron micrograph of a domesticated goosefoot (*Chenopodium berlandieri*) seed from Ash Cave, Ohio; along with a thin seed coat, one of the morphological markers of domestication in this species is the flattened (rather than rounded) seed margin, shown on the right edge, opposite the 'beak' (after B. D. Smith, 1995a: 187; photograph kindly provided by Bruce Smith)



have been encouraging, managing, and manipulating these plants for some considerable time before selection and genetic changes registered such distinctive morphological changes (Asch and Asch, 1985; Heiser, 1985; Johannessen, 1984, 1988; King, 1985; P. J. Watson, 1985, 1989; Watson and Kennedy, 1991; Yarnell, 1977).

Given the primacy of cultivated bottle gourds and pepo squash, one thesis has been that they were introduced as domesticated plants to North America by exchange from Central America. Another is they entered naturally as wild plants and were then domesticated. Another idea is that wild or domestic plants could have floated up the Gulf Coast. The balance of probability, though, is that they were locally available plants, and that they were domesticated locally (Heiser, 1989). It has been proposed that bottle gourds might have been selectively grown because they were valued for shamanistic purposes as magical rattles or containers for medicines and stimulants (Prentice, 1986), and that pepo squashes, found first at riverine sites, might have been valued primarily because they would have been ideal as net floats (Fritz, 1999). By 500 BC the full range of domesticated seed plants, together with tobacco (*Nicotiana rustica*), was commonly present at sites in the major river valleys of the eastern Woodlands such as Newt Kash, Cloudsplitter shelter, Salts Cave, and Mammoth Cave in Kentucky, Icehouse Bottom in Illinois, and the Edwin Harness mound in Ohio (Chapman and Crites, 1987; Fritz, 1990; B. D. Smith and Cowan, 1987). Coprolites from Salts Cave and Mammoth Cave indicate a vegetable diet dominated by chenopods, sunflower, maygrass, and sumpweed (P. J. Watson, 1974).

The increasing importance of cultivated plants in the diet coincides with larger woodland clearances, the consistent use of chert hoes, and the

increasing use of hickory and oak for fuelwood, the latter a sign that these trees were less protected as a valuable food source as plant horticulture gained momentum (Johannessen, 1984, 1988). Marsh elder, goosefoot, maygrass, and little barley were probably harvested by beating the seed clusters into baskets; sunflower heads were cut off; and knotweed plants were probably pulled out of the ground entire, then dried and threshed (Smith, 1992b). The grass seeds were parched, sunflower seeds dried, the rinds of squashes and gourds cut into strips and dried and the seeds separated. The harvested plants were stored in a variety of pots, gourds, baskets, and basket-lined pits before being ground and boiled for consumption.

Watson and Kennedy (1991) suggested that, as women were primarily the gatherers, the development of floodplain horticulture in the eastern Woodlands could well have increased women's economic and social importance. However, there are no indications of significant shifts in gender roles in the material culture, and it is apparent that hunting, fishing, and shellfish collection were also critical for subsistence. Ethnographic examples indicate that men may have taken the lead role in the first two and women in the last. In many horticultural societies, also, labour is shared, men taking the primary role in clearing fields, women in tending the crops, with both involved in harvesting. It is difficult to see how major transformations in gender roles would have been possible in societies in which the primary production unit seems to have been the individual household (B. D. Smith, 1993).

The mixture of horticulture, fishing, shellfish- and plant-gathering, and hunting, sustained societies in the eastern Woodlands that were both numerous and socially complex. These are termed Hopewell, and date from c.500 BC to AD 200 (D. K. Charles and Buikstra, 1983; Fiedel, 1987; Gibson, 1994; Saunders *et al.*, 1994). Settlements such as Koster and Carlston Annis consist of quite substantial dwellings, extensive middens, and storage facilities (a pit at Marble Bluff in the Ozarks on the Missouri–Arkansas border contained a stash of chenopod seeds, for example), though most sites seem to have been for just one or two households (Fritz, 1990). A distinction has been noted between what seem to be permanent settlements in river valleys and seasonal camps elsewhere. Stone industries indicate increasing diversification of use and specialization of production. Elaborate ceremonial monuments were constructed. Barrow cemeteries were often sited at prominent locations visible from a distance. Hopewell itself consisted of almost forty mounds (some 250 burials) within a substantial rectangular enclosure. Indian Knoll was another major mortuary landscape, with over a thousand burials. Hopewell mortuary rituals were elaborate and variable. There are examples of dissection, excarnation, disarticulation, display, and bundling. The remains were placed variously in above-ground charnel houses and timber-lined mortuary pits; dog burials

were also quite common (J. A. Brown, 1979). Many people were buried with exotic grave-goods, such as stone artefacts from a variety of distant sources, grizzly bear teeth, and obsidian from the Yellowstone region, marine shells and barracuda jaws from the Gulf, and native copper from the Great Lakes region (Dye, 1996; King, 1985). Such exotics had acquired very high prestige value by the time they reached the Hopewell centres (Brose, 1990).

Presumably these long-distance exchange networks, originally defined as the 'Hopewell Interaction Sphere' by Struever (1964), were the mechanism by which Hopewell societies gradually acquired new domesticated plants from the tropical regions to the south, notably maize. The combination of sedentism, settlement clustering, subsistence intensification, craft development, long-distance exchange of prestige goods, formalized and elaborate mortuary rituals, and signs of distinct social differences in the grave-goods, has been used to suggest the development of chiefdoms amongst Hopewell societies. Though the thesis has been criticized (there is little evidence for the development of hereditary leadership amongst these societies, for example), there can be little doubt that the mix of foraging and horticulture that developed in the major river valleys of the eastern Woodlands between c.5000 BC and 1500 BC provided the foundation for societies that were characterized not just by tight formal structures but also by increasing social differentiation and inequality (Rothschild, 1979).

DRYLAND FORAGING AND FARMING IN THE SOUTH-WEST

In the drylands centred on the modern states of Utah, Colorado, Arizona, and New Mexico, the desiccated plant remains from Bat Cave were at first thought to demonstrate the beginnings of maize cultivation from about 5000 BC (MacNeish, 1965). However, AMS dating of the maize cobs then showed that they are probably no older than about 1000 BC (Berry, 1985; Wills, 1992). The present indications are that maize, squash, and beans were probably being cultivated in the region from about 1000 BC, though pollen from Chaco Canyon suggests that the date might be pushed back a thousand years (A. H. Simmons, 1986). Recent discoveries near Zuni pueblo in New Mexico indicate that these early cultivation systems may have employed small-scale irrigation technology (Damp *et al.*, 2002), and terracing was employed at Cerro Juanaqueña in north-western Mexico (Hard and Roney, 1998). The consensus view is that the adoption of crop cultivation by South-Western foragers had little significant impact on their way of life for almost two millennia (Matson, 1991; Minnis, 1985, 1992; Wills, 1988, 1992, 1995), though AMS dating of irrigation canals to as early as 1000 BC suggests that in the more arid

regions at least, even small-scale maize cultivation required quite considerable investment in irrigation technology to be worthwhile (Damp *et al.*, 2002).

Before these crops were available, bands of foragers wintered at lower elevations by streams and moved into wooded uplands for the summer and autumn. They hunted wild sheep, antelope, mule deer, and smaller game, and collected the fruits of plants such as mesquite and cactus and grass seeds. The critical time of the year would have been the spring, when stored plant foods from the previous season were likely to be low and the coming season's fruits and nuts were not yet available for harvesting. The appearance of maize and other crops at Bat Cave coincides with the construction of storage pits and fire-pits there, and fragments of yucca cordage and rabbit fur robes, suggesting that caves and rock-shelters like this came to be valued as natural locations for storage and processing. Grinding equipment was used for processing a variety of plants, not just for maize (Hard, 1990). The evidence from the food remains that broad-spectrum foraging still provided the greater part of the diet after 1000 BC is confirmed by studies of coprolites and isotope analyses of skeletons (Lynott *et al.*, 1986). Also, the fact that people made baked-clay figurines but not pottery suggests that they had little need for containers to boil and steep maize.

Foragers in the South-West probably began to use maize and other crops after c.1000 BC not to change their way of life but to preserve it (Wills, 1992). Early forms of maize were not very productive compared with sunflowers, pinyon nuts, walnuts, and so on, but they were well suited for storing. Foragers grew small quantities of maize and stored it in upland caves like Bat Cave, Tornillo in the lower Rio Grande, Sheep Camp Shelter in Chaco Canyon, or Three Fir Shelter on the Colorado plateau. By these means they could move into the highlands rather earlier than had been possible before, using the maize they had cached there to fill the 'hungry gap' between seasonally earlier foods such as cactus fruits, mesquite, acorns, and seeds, and later ones such as pinyon nuts and juniper berries. In short, Wills argues, the use of cultigens represented simply a tactical shift to reduce risk, not a transformation in subsistence strategies to increase returns. It is difficult to identify any particular context for why cultigens started to be used when they were. One factor, he suggests, might have been the warmer and drier climate of the period, which would have favoured the expansion of pinyon woods and grassland (and the ungulates that grazed it), perhaps encouraging a degree of population growth in the region.

When maize farming was finally established in the South-West as the main-stay of subsistence during the course of the first millennium AD, it was, significantly, associated with dramatic transformations in cultural complexity. These societies are termed Hohokam in southern Arizona, Mogollon in southern

New Mexico, and Anasazi in northern New Mexico and southern Colorado (Berry, 1982; Crown and Judge, 1991; Gumerman, 1991; Sebastian, 1992). There was a rapid increase in population marked not just by many more sites but by dramatic changes in their character. Many consisted of multiple substantial dwellings grouped around a central courtyard, with ovens, middens, and storage pits by the houses and cemeteries beyond. Excavations show year-round residential patterns at these sites, in some cases of populations in hundreds. By the early centuries of the second millennium AD, the largest sites were enormous complexes not just of domestic units but also elaborate public spaces and buildings such as the 'ball courts' and 'kivas' (subterranean ceremonial chambers) of Pueblo Bonito in Chaco Canyon and Mesa Verde. By contrast with the earlier foraging/farming societies of the South-West, that are assumed to have been organized along communal lines, with decision-making carried out within kinship structures, these societies were organized hierarchically, with institutionalized systems of leadership (Kantner, 1996; Sebastian, 1992). Violence also was institutionalized, and endemic.

These systems of political integration, integrative ideologies, and inter-group competition were the context in which communities transformed the landscape to increase agricultural production. Hill-slopes were terraced, and diversion walls and check dams were built to control floodwaters and use them to irrigate fields. In the desert basins of Phoenix and Tucson, extensive networks of canals were dug to divert rivers and expand the cultivated area (Fish and Fish, 1984, 1994; Sandor *et al.*, 1990; Fig. 7.8). As with the earlier incorporation of cultigens into existing systems of foraging, this dramatic process of agricultural intensification is thought to have coincided with climatic changes that were favourable rather than stressful, in this case with a period of improved rainfall. Sebastian (1992) argues that this permitted surplus production, allowing some individuals and households to capitalize on their material success at the expense of others. In time, though, the irrigation systems caused major erosion, with significant political repercussions (Waters and Ravesloot, 2001).

Given the scale and ingenuity of activities undertaken to enhance crop farming, it is interesting that these farmers never attempted to domesticate the wild bighorn sheep that were endemic to the region (Carr, 1977). Though in some respects similar to the Eurasian mouflon, bighorn sheep prefer much more rugged terrain, and are more solitary animals, so behaviour and ecology presumably combined to make them less attractive as potential stock than the wild sheep of Eurasia. There is no evidence even for their selective hunting, though interestingly they seem to have had special symbolic value for many hunter-gatherers at this time: their depictions in rock art are suspected to have been an important mechanism by which shamans mediated with the supernatural (Whitley, 1994).

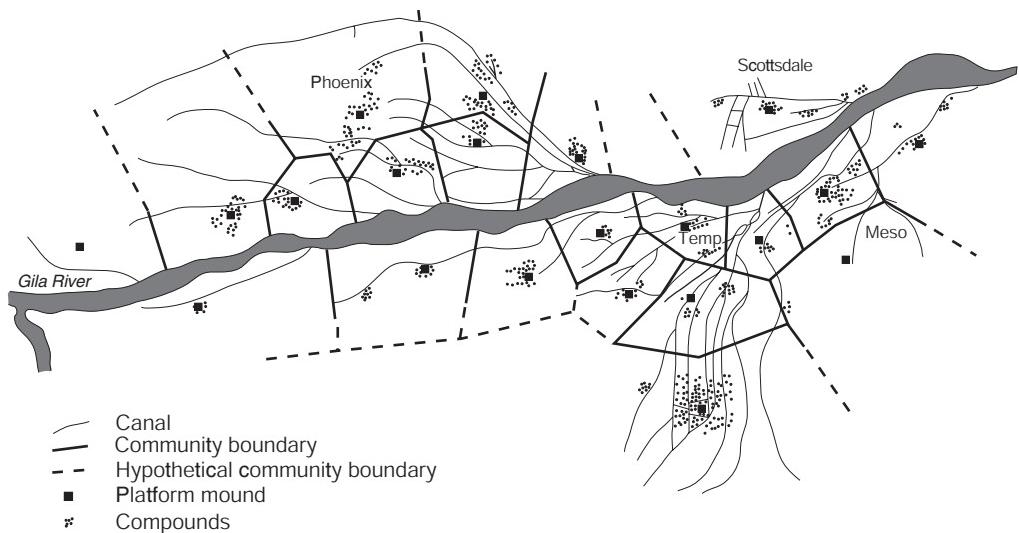


Fig. 7.8. Prehistoric Hohokam communities and irrigation systems in the Phoenix basin of the Salt river (after Minnis, 2000: fig. 15.2)

MAIZE FARMING IN NORTH AMERICA

Maize seems to have been present from at least the beginning of the first millennium AD in the central Mississippi region, on the evidence of AMS dates on corn cobs from sites such as Icehouse Bottom (Chapman and Crites, 1987) and the Edwin Harness mound (Fritz, 1993), but it did not become a staple for another thousand years (Fritz, 1990, 1994; Johannessen and Hastorf, 1994; Lynott *et al.*, 1986). It probably spread by a process of small-scale exchange within the domestic sphere, one mechanism perhaps being the movement of women through marriage, taking maize husbandry and processing skills with them (S. Martin, *pers. comm.*). As maize farming began to supplant the existing mixed systems of seed cultivation and foraging, thinner more efficient pottery vessels and heavier hoes were manufactured, special vessels were designed for parching and cooking maize, and the size of storage pits was increased. Residues of C4 plants in pottery are probably further evidence for maize processing (Reber *et al.*, 2004). There are indications of rising populations. Many sites consist of small clusters of farmsteads; a few look more like villages. Earlier weaning and shorter birth intervals are further signs of rising populations (Buikstra *et al.*, 1986).

From early in the second millennium there is widespread evidence for crop husbandry systems based on the 'full triad': maize, beans, and squash. The increasing reliance on the new staples, maize especially, affected health

detrimentally, but not equally for all members of society. The amount of enamel hypoplasia in skeletons from the Dickson Mounds, for example, indicated an increase in weaning-related stress as maize became a staple food for the community, the newborn babies suffering from being fed a maize gruel high in carbohydrate but low in protein (Goodman *et al.*, 1984). A study of a Georgia community found that women were worse affected than men by the change to maize horticulture (Larsen, 1984): the men continued to benefit from hunting and fishing, whereas the women had poorer teeth and bone structure from their new diet, and more signs of biomechanical stress from working the fields.

The early twelve-row varieties of maize were poorly adapted to cooler latitudes, but when new eight-row varieties were developed such as Northern Flint adapted to shorter growing seasons (Cowan, 1985), maize cultivation spread across North America with astonishing speed. Carbonized cooking residues adhering to potsherds from three sites in the northern Finger Lakes region of New York south of Lake Ontario (Kipp Island, Hunter's Home, and Wickham) contain maize and squash phytoliths and have been AMS-dated to the mid-first millennium AD (Hart *et al.*, 2003). Maize cultivation began in the Great Lakes region at about this time (Crawford and Smith, 1996; Crawford *et al.*, 1997; D. G. Smith and Crawford, 1997). At the Schultz site on the Saginaw River, for example, maize swiftly became a staple food for foragers who had successfully relied hitherto on the wealth of wild plant and animal foods available in the surrounding wetland and woodland (including wild rice, nuts, fruits, white-tailed deer, turtles, and over 25 species of fish), supplemented by the small-scale cultivation of chenopods and squashes (Lovis *et al.*, 2001). Many northern foraging societies seem to have adopted maize farming within a few generations of the new crop being available, the transition being so complete that even their dogs were maize-fed (Fritz, 1990; Schwartz and Schoeninger, 1991). Some farmers in the cooler wetter regions developed systems of ridging rather like Irish 'lazy-beds', so that maize could be grown even on poorly drained land (Gallagher, 1989; Gallagher *et al.*, 1985).

Many North American societies, however, remained wholly or largely foragers for many centuries, even though most were in trading contact with farmers. In the most arid regions, it was simply not possible or viable to practise farming. This was the case on the Gulf Coast, for example (Story, 1985), and also in western Texas. Isotope studies of skeletons at sites in the Texas Panhandle, for example, indicate diets largely of buffalo meat and desert fruits, with very occasional maize (Schwartz and Schoeninger, 1991). Coprolites from Bakers Cave near the Mexican border reveal that people here were eating almost anything and everything they could find: onion bulbs, prickly pear seeds, mustard seeds, juniper seed hulls, mesquite pods, goosefoot seeds,

fish, birds, lizards, rodents, and rabbits (Sobolik, 1990). At the other extreme, the wealth of wild foods on the northern coasts sustained populous communities based especially on sea fishing and sea mammal hunting, such as those of Passamaquoddy and Penobscot Bays in Maine (Bourque, 1995; Robinson *et al.*, 1992; Sanger, 1996). Some of these seem to have been relatively small-scale societies living in family groups in wigwams, moving from resource to resource (especially between the coast and the adjacent hinterland) rather than storing food. There were comparable societies on the major rivers in inland New England (Dincauze, 1976). In other cases, especially in estuary locations with the greatest diversity and density of food sources, European colonists encountered substantial communities in longhouses (or longtents), more or less sedentary, characterized by food storage, elaborate mortuary rituals, and what seem to have been marked differences in social status. The Scowltz site on the lower Fraser river in British Columbia was such a foraging village, the plant remains of which demonstrate all-year-round occupation (Lepofsky and Lyons, 2003).

SQUASH, MAGUEY, AND MAIZE CULTIVATION IN THE HIGHLANDS OF CENTRAL AMERICA

The starting point for any discussion of the Central American evidence has to be the classic sequence of subsistence change established by MacNeish and his colleagues from their surveys and excavations in the Tehuacán valley in the arid highlands of central Mexico (Byers, 1967; MacNeish, 1965; Fig. 1.5). There were two key trends: domestication and plant cultivation were being practised from about 7000 bc; but the shift from foraging to farming was very gradual, with settled village life based on farming only being established by about 1500 bc. The earliest plant remains found were seeds of chilli peppers and some avocado stones in what was termed the Ajuereado phase, dated to before 7000 bc. The first evidence for agriculture (fragments of domesticated pepo squash and avocados, together with cotton, chilli, and amaranth seeds, and maize pollen) was in the El Riego phase, c.7000–5000 bc. By the next phase, Coxcotlan (5000–3400 bc), though people were still basically foragers, they were cultivating domesticated maize, common beans, bottle gourds, chilli, warty squash, and amaranth. A quarter of the diet was estimated to come from agriculture in the next phase, Abejas (3400–2300 bc), when the first sedentary sites were identified. Village life based on farming finally developed in the Ajalpan phase, 1500–900 bc.

A somewhat similar sequence was proposed by Flannery (1976, 1986) for the Oaxaca valley, also in the Mexican highlands. Fragments of pepo squash

and bottle gourd and maize pollen were recovered from levels in the Guilá Naquitz cave dated to 8000–7000 BC, but people relied on hunting and gathering for many millennia. Sedentary village life based on farming was finally established in the second millennium BC, termed the Formative period.

As with the evidence from Bat Cave, however, it has since become clear that some of the deposits investigated in these excavations must have been disturbed. One problem with cave sediments containing desiccated plant remains, for example, is that the latter are extremely attractive food for burrowing rodents. When AMS dating of the maize cobs from Tehuacán that are accepted as domesticated (Benz and Iltis, 1990) showed that they were no earlier than about 3500 BC, and radiocarbon dates indicated that the Guilá Naquitz sediments (in fact not much over a metre thick) had also suffered from mixing, models of the antiquity of early farming in Central America began to be drastically revised downwards (Fritz, 1994; B. D. Smith, 1995a). Nevertheless, AMS dates on squash fragments from Guilá Naquitz have since confirmed their antiquity, as the samples have been variously dated to between 8000 and 6000 BC (Smith, 1997), whilst maize cobs have been dated to between 4500 and 4000 BC (Piperno and Flannery, 2001). Although many fragments of the squash at Guilá Naquitz are within the thickness range for present-day wild *Cucurbita*, a quantity demonstrates the changes in shape, colour, and rind thickness characteristic of modern domesticated squash. It therefore seems likely, after all, that highland foragers in Central Mexico began to manipulate plants from very early in the Holocene, including maize.

The critical point remains, though, that they continued to rely on broad-based hunting and gathering for many thousands of years (de Tapia, 1992), over time developing more logistical systems of foraging in response to increasing aridity and rising populations. In the valley of Oaxaca, for example, people came together in rainy-season (June–September) base camps such as Gheo-Shih to plant gourds and squash and collect mesquite pods and hackberry, dispersing to small higher-elevation camps such as Guilá Naquitz in the dry season (October–December) to gather acorns and pinyon nuts (Flannery, 1986; Marcus and Flannery, 2004). They also hunted a wide variety of game, in part using communally organized deer and rabbit drives. In the coldest and driest parts of the highlands (the *tierra fría*), one of the most important group of plants taken into cultivation was probably the agave cactus or maguey, because it is highly resistant to drought, frost, and hail (Parsons and Darling, 2000). The leaves, heart, and stalk are all edible when cooked. If the mature plant is ‘castrated’ to halt the flow of sap to seed-bearing stalks (Fig. 7.9), daily scraping can yield 5,000–9,000 litres per year which can be drunk as it is, fermented to make a beer-like liquid (*pulque*), or boiled down to make a thick storable syrup. The leaf can also be turned into fibre.



Fig. 7.9. Castrating a mature maguey plant (Parsons and Darling, 2000: fig. 16.3; photograph kindly provided by Jeffrey R. Parsons)

Hayden (1990, 1995) has proposed that agriculture began in places like the Oaxaca valley in the context of competing group leaders wanting ever more plentiful and prestigious food for feasts. However, whereas competitive behaviour can easily be understood as a driver of social and economic change amongst sedentary, populous, and complex forager societies such as those of coastal Peru (see below), Japan (Chapter 6), or north-west Europe (Chapter 9), the early Holocene archaeology of the Central American highlands indicates much smaller-scale and mobile societies, with signs of sedentism and ranking only apparent in the Formative period. As with the desert foragers to the north, foragers in the uplands of Central America probably began the small-scale cultivation of plants as another strategy to reduce risk, increase resource predictability, and lessen the impact of environmental extremes. There was a long period in which they operated rather like the Natufians in South-West Asia: hunting, collecting, and practising various forms of plant manipulation such as propagating hardy cultivars in stream gullies near the caves they returned to regularly. They became increasingly sedentary in the process.

A crucial development, as in South-West Asia, was the eventual shift to permanent villages by alluvial soils at lower elevations than most of the caves, sustained wholly or largely by maize-based agriculture. These new villages became the foci of increasingly complex and competitive 'Formative' societies characterized by specialization in craft production, public ceremonial or ritual behaviours, trade in prestige goods, and above all increasing differentiation in wealth and status marking the emergence of elite groups. San José Mogote in Oaxaca, for example, consisted of a cluster of dwellings with beaten clay floors and wattle and daub walls, equipped with ovens, hearths, and storage facilities, together with central public or ceremonial structures of some kind (Flannery, 1976; Marcus and Flannery, 2004). Contemporary villages in the Tehuacán valley were structured along similar lines.

During the long history of mixed foraging and small-scale cultivation in the central highlands, new plants were incorporated into the system from contact with people living in the tropical lowlands. Maize was one of this suite of tropical plants. The origins of maize have been debated for decades, the commonest thesis being that it must somehow have developed from teosinte (*Zea mays* ssp. *parviflora*), a wild member of the same family (Beadle, 1977). However, the two plants are very different: teosinte has a series of stems, not the single stem of maize; it has a series of small spikes rather than a single large cob; and the spikes each have their own husk, whereas the maize cob is enclosed in many layers of husk. An alternative thesis, proposed for example by Mangelsdorf (1965), was that maize must have developed from an ancestral (more maize-like) plant that is now extinct. Modern genetic studies, however, make it quite clear that maize developed from teosinte (Benz and Iltis, 1990; Doebley, 1990; Galinat, 1985; Iltis, 1983; Wilkes, 1989), a quite remarkable example of a plant's transformation under human manipulation (Fig. 7.10). The most maize-like teosinte has been found in the Balsas valley in the tropical lowlands of western Mexico, about 250 kilometres west of Tehuacán (Doebley, 1990), and genetic studies of modern maize point to this region as the focus of maize domestication (Matsuoka *et al.*, 2002; Wang *et al.*, 1999). Human selection for cob size over generations eventually made the plant sufficiently productive to make sedentary settlement a viable option.

'DOORYARD HORTICULTURE' IN TROPICAL CENTRAL AMERICA

Although Sauer (1952) held that the humid tropics of Central and South America were likely to be critical centres of plant domestication in the Americas, for a long time the thesis found little support. This was partly because



Fig. 7.10. Wild teosinte and maize ears and plants compared (after Galinat, 1985: fig. 8.1)

tropical soils were generally thought to be poor, but mainly because archaeological research addressing questions of agricultural origins concentrated on arid and temperate environments where botanical and faunal remains were more likely to survive (Chapter 1). There has now been a transformation in our understanding of the prehistory of tropical cultivation systems in the Americas, based in particular on the study of pollen, phytoliths, and starch rather than on macroscopic plant remains. Dolores Piperno and Deborah Pearsall have played the leading role in this research (Pearsall, 1989, 1992, 1995, 2002; Piperno, 1985, 1989, 2003; Piperno and Pearsall, 1998). By combining the evidence of the present-day distributions and habitat preferences of the wild plants that are presumed to be the ancestors of modern cultigenes, the postulated nature of early Holocene vegetation, and the evidence in the archaeological record of pollen, phytoliths, starch, and macroscopic plant remains, they make a convincing case that the various regions within tropical Central and South America where many plants were probably first domesticated can be identified quite precisely, and at least the 'macro-regions' for several other plants (Table 7.1; Fig. 7.11).

The methodologies for distinguishing wild and domestic plants on the basis of phytolith size and morphology are increasingly robust (Pearsall *et al.*, 2003, 2004). The fact that root and tuber crops do not produce phytoliths means that there is still very little information about the domestication history in

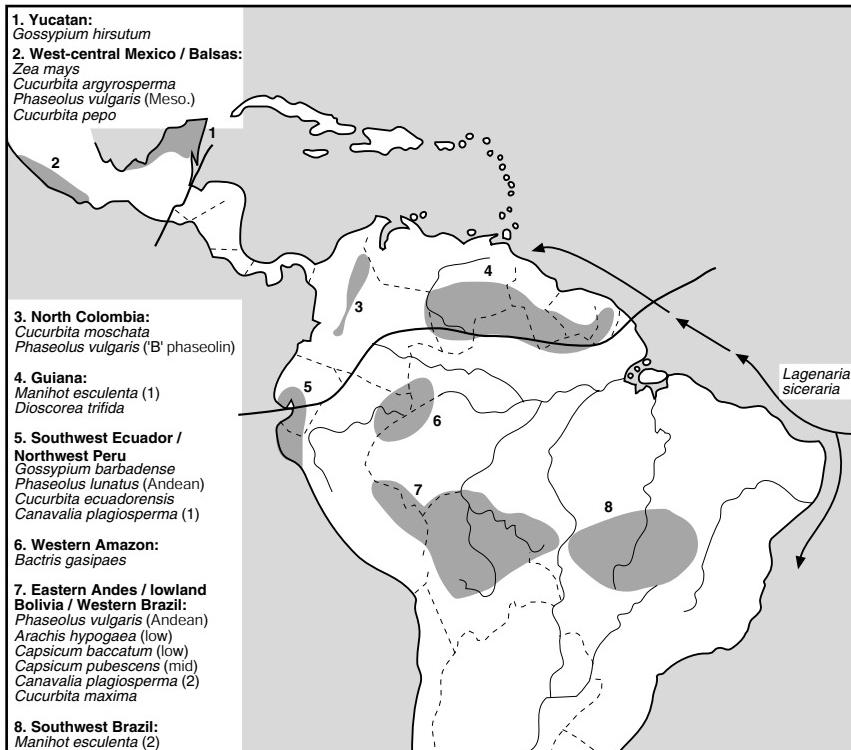
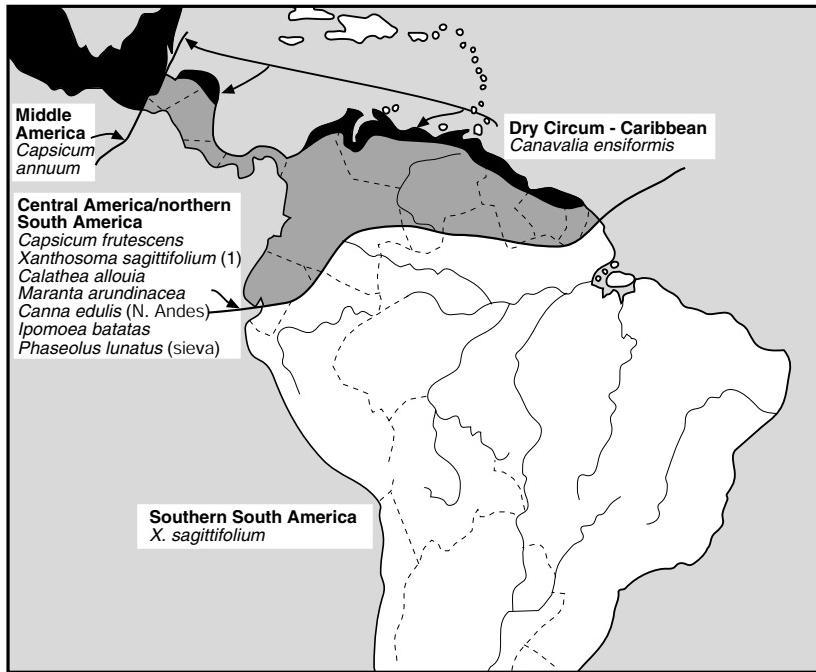


Table 7.1. Probable regions where crops were domesticated in the tropical lowlands of Central and South America

<i>Likely domestication areas</i>		
Yucatan	<i>Gossypium hirsutum</i>	Cotton
West-central Mexico	<i>Zea mays</i>	Maize
	<i>Cucurbita argyrosperma</i>	Squash (silverageed gourd)
	<i>Phaseolus vulgaris</i>	Common bean
	<i>Cucurbita pepo</i>	Summer squash or marrow
Northern Colombia	<i>Cucurbita moschata</i>	Butternut squash
	<i>Phaseolus vulgaris</i>	Common bean (B phaseolin type)
Guiana	<i>Manihot esculenta</i>	Manioc/yucca/cassava
	<i>Dioscorea trifida</i>	Yam
South-west Ecuador, north-west Peru	<i>Gossypium barbadense</i>	Cotton
	<i>Phaseolus lunatus</i>	Andean lima bean
	<i>Cucurbita ecuadorensis</i>	Squash
	<i>Canavalia plagiisperma</i>	Jack bean
Western Amazon	<i>Bactris gasipaes</i>	Peach palm
Eastern Andes/lowland Bolivia/western Brazil	<i>Phaseolus vulgaris</i> (Andean)	Common bean
	<i>Arachis hypogaea</i>	Peanut
	<i>Capsicum baccatum</i>	Chilli pepper
	<i>Capsicum pubescens</i>	Chilli pepper
	<i>Canavalia plagiisperma</i>	Jack bean
	<i>Cucurbita maxima</i>	Warty squash
South-west Brazil	<i>Manihot esculenta</i>	Manioc/yuca/cassava
<i>Likely domestication macro-regions</i>		
Middle America	<i>Capsicum annuum</i>	Chilli pepper
Dry circum-Caribbean	<i>Canavalia ensiformis</i>	Jack bean
Central America/northern South America	<i>Capsicum frutescens</i>	Chilli pepper
	<i>Xanthosoma sagittifolium</i> (1)	Cocoyam
	<i>Calathea allouia</i>	Leren
	<i>Maranta arundinacea</i>	Arrowroot
	<i>Ipomoea batatas</i>	Sweet potato
	<i>Phaseolus lunatus</i>	Sieve-type Lima bean
Southern South America	<i>Xanthosoma sagittifolium</i> (2)	Cocoyam

Note: Non-tropical species probably domesticated in the Andes included *Canna edulis* (Achira), *Cucurbita maxima* (Squash) and *Cucurbita ficifolia* (Squash or Malabar gourd). See also Fig. 7.11.

Sources: Piperno and Pearsall, 1998: 163–5, with emendations following findings of Sanjur *et al.*, 2000.

Fig. 7.11. The likely domestication areas for various crop plants in Central and South America (after Piperno and Pearsall, 1998: figs 3.18 and 3.19, with emendations following findings of Sanjur *et al.* (2000); see also Table 7.1)

the Americas of major staples such as yam, taro, manioc, and sweet potato. The use of starch grains and parenchyma (plant tissues) that has provided such a methodological breakthrough in the study of tropical foraging and farming in South-East Asia is also being developed for the tropical regions of America (L. Perry, 2002, 2004; Piperno, forthcoming; Piperno *et al.*, 2000). Nevertheless, the pollen and phytolith evidence is sufficient to demonstrate that most of the plants being cultivated by indigenous American societies at the time of European contact probably originated from the tropical regions. As far as the tropical lowlands of Central America are concerned, Piperno and Pearsall (1998) argue that maize was probably domesticated in the Balsas valley region of western Mexico along with squash and common bean, that the common bean was also domesticated separately in the tropical highlands of Guatemala, and that cotton was domesticated in the Yucatan peninsula. Studies of chloroplast DNA polymorphisms also point to separate domestications of the common bean in Mesoamerica and in the Andean region (Chacón *et al.*, 2005).

Some of the best archaeological data has come from Panama, from the work of the survey and excavation landscape study termed the Proyecto Santa María in Parita Bay (Cooke and Ranere, 1984, 1989, 1992; Ranere and Cooke, 2003; Ranere and Hansell, 1978). At the beginning of the Holocene there was a population of foragers here, using short-occupation camps on the coast and by inland streams. They relied on fishing, shellfish collection, plant gathering, and hunting animals such as the nine-banded armadillo, raccoons, rats, and lizards. The lack of the blowgun is thought to be the reason why many obvious prey such as peccaries, monkeys, and large forest birds were not caught. In levels dated to between 8000 and 5000 BC, Cueva de los Vampiros had phytolith evidence for palm and Marantaceae, probably the arrowroot *Maranta arundinaceae*, the tuber of which is a good source of easily digestible starch. Piperno (1985, 1989) concluded that arrowroot was probably being cultivated or managed in some way, given that it does not grow by the site today and was unlikely to have been growing there naturally in the early Holocene (palaeoecological evidence suggests a dry, open, and windswept landscape at that time). There were also squash phytoliths, but too few to establish on size criteria whether or not they were being cultivated. Carbonized fruits of the coyol palm were recovered from deposits of similar antiquity in two other rock shelters, Corona and Carabalí.

Between 5000 and 2500 BC people continued to use short-season camps on the coast and inland to practise broad-based foraging. The fauna from Cueva de los Ladrones and Aguadulce included fish, shellfish, white-tailed deer, collared peccary, squirrel, crocodile, and snake. There was pollen and phytolith evidence for palm and arrowroot at both sites, and at Aguadulce

squash and leren (*Calathea allouia*: another plant producing tubers with easily digestible starch), together with rind fragments of bottle gourd. Maize phytoliths at the latter site probably derive from a hard-glumed *Zea*; they were more similar to those of modern teosinte than modern domesticated maize, though this is to be expected given the presumption of a long period of teosinte cultivation before it developed into maize as we know it today. Starch grains on stone cobbles from Aguadulce may derive from yams and manioc. Between 2500 and 1000 BC there were much longer occupations at Cueva de los Ladrones and Aguadulce, and an array of botanical evidence including starch grains of manioc, maize, and yam (probably *Dioscorea trifida*) on grinders indicates systematic horticulture (Piperno *et al.*, 2000). People also started to make pottery, which would have been particularly useful for making griddles for baking manioc. Farming at this time was still integrated with foraging, though, especially the intensive collection of coastal resources (fish, shellfish, waterfowl, reptiles, amphibians) from specialized camps such as Cerro Mangote. There is some phytolith evidence that maize improved in size at this time. Substantial permanent villages such as La Mula were established in the first millennium BC, coinciding with isotopic evidence for a maize-dominated diet (Norr, 1995), though manioc and yams were also critical.

This archaeological sequence is amplified by palaeoecological studies of cores taken from lake sediments in the region. The phytolith, charcoal, and pollen profile from Lake La Yeguada indicates small-scale disturbances to the forest during the early Holocene, a significant decline in forest from about 5000 BC, and then major clearances in the second and first millennia BC (Bush *et al.*, 1992; Piperno *et al.*, 1991; Fig. 7.12). Similar studies of other lake cores in tropical Central America have not found evidence for early Holocene forest disturbances, but support the Lake La Yeguada sequence with indications of swidden farming developing 4,000–5,000 years ago and intensive farming 3,000–4,000 years ago (Pearsall, 1995: 189). At Gatun Lake in Panama, there is evidence for maize cultivation by c.3000 BC and swiddening c.1500 BC (Piperno, 1985). In the Cobweb Swamp near the Mayan site of Colha in Belize, the appearance of maize and manioc pollen coincides with clearance evidence indicating the beginnings of swiddening c.2000 BC (J. G. Jones, 1994). At Petapilla near Copan in Honduras, maize farming and swiddening started c.3000 BC (Rue, 1987, 1988).

In combination, the archaeological and palaeoecological data suggest that Holocene foragers in tropical Central America were manipulating the tropical forest from the outset, including disturbing ground to encourage useful food plants and grazing animals, and probably moving and tending plants as well, what Piperno and Pearsall term 'dooryard horticulture'. They argue that these

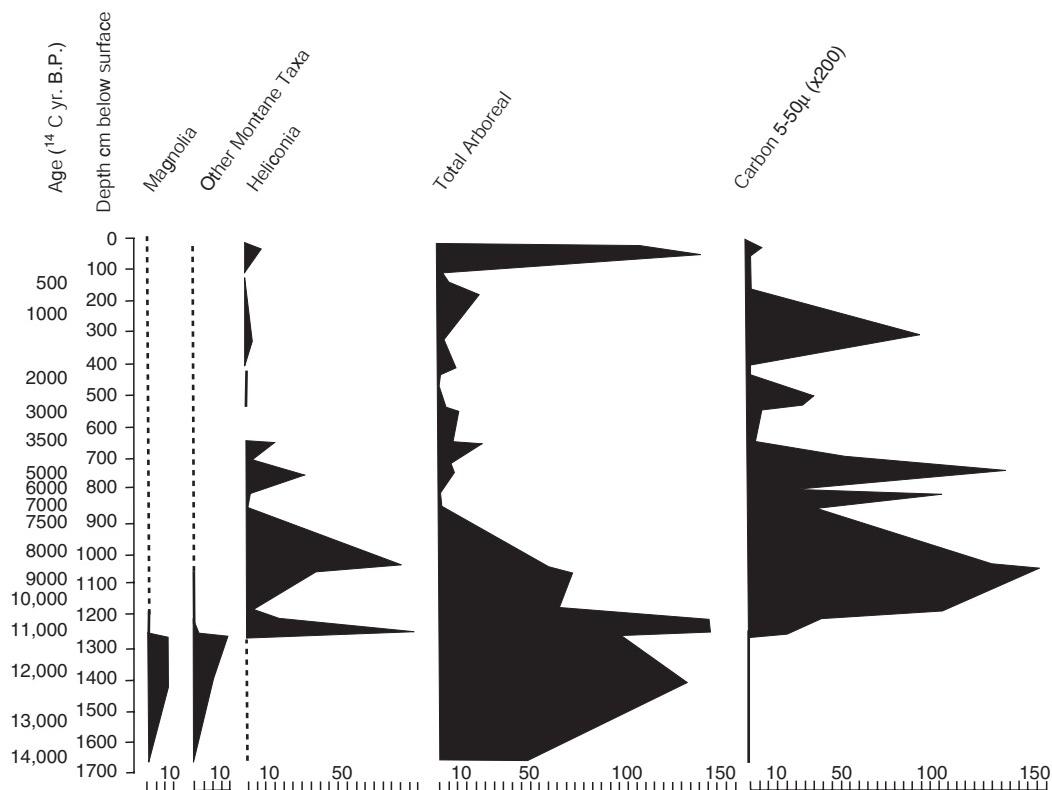


Fig. 7.12. Summary phytolith and charcoal profile from Lake La Yeguada, Panama, showing the Pleistocene disturbance horizon and its continuation and intensification during the early Holocene, with forest declining due to the onset and intensification of swidden agriculture; phytolith and charcoal values are expressed in absolute rates of deposition; total arboreal = the sum total of all arboreal and arboreal-associated phytoliths, which are largely from the primary forest; carbon = charcoal; the basal scales show absolute frequencies (after Piperno and Pearsall, 1998: fig. 5.8)

tropical foragers began to practise forms of horticulture from the very beginning of the Holocene because foraging costs were increasing compared with in the late Pleistocene. The late Pleistocene tropical landscape was a mosaic of low woodland, thorny scrub, and savannah, but as these were replaced by wetter, much denser, forests, people would have found themselves working harder for fewer returns. It would have been difficult if not impossible to intensify existing systems of foraging: the lack of the blowpipe (we assume) is one example of a technological limitation on hunting, and the denser the forest the more thinly spread and inaccessible would have been the edible plants and animals. By making small 'interventions' to the landscape, it was possible to

tip the balance in people's favour, making desirable food sources more reliable, more accessible, and probably more abundant. For a long time small-scale horticultural activities served to support foraging, but the greater availability of cultivated plants, especially ones well suited to be staple foods, gradually pulled people more and more into horticulture. By 5000 BC these practices had developed into what is clearly recognizable as swidden agriculture, including the cultivation of maize presumably acquired through exchange (Pope *et al.*, 2002), though swiddening was still closely integrated with foraging.

There was then a major step in intensification, as in the highlands of Mexico, with the development of Formative villages based for the most part on the cultivation of permanent fields. They were characterized by competitive hierarchical societies, as in the highlands. Paso de la Amada in Chiapas, southern Mexico, has evidence for a division between elite and commoner households (Blake, 1991), La Blanca in Guatemala for public and domestic architecture (Love, 1991), and La Mula in Panama for marked differences in wealth in grave-goods. Exotics such as obsidian, shells, and iron were obtained through exchange networks for use as status markers. The same kind of social elaboration took place in the Mazatán region of lowland Mexico near the Guatemalan border, though exceptionally here it seems to have been founded on the exploitation of rich marine resources (Blake *et al.*, 1992).

The transformation of a tropical lowland settlement during the course of the first millennium BC from a collection of small households to a socially differentiated village with central ceremonial buildings is particularly clear at Cuello in Belize (Hammond, 1991). A wide variety of meat was consumed by the (mainly elite) community at Cuello not only from prey such as white-tailed deer, large rodents, peccary, turkey, turtles, and fish, but also from domestic dogs (Wing and Scudder, 1991). The evidence of people's tooth wear, though, together with carbonized plant remains and fragments of parenchyma, demonstrated that the diet depended on maize, squash, beans, and tubers such as manioc (Hather and Hammond, 1994; Miksicek, 1991). This was probably typical of the region. Furthermore, the steady increase in the size of the maize cupules and kernels at Cuello suggests that maize became an increasingly productive crop during the lifetime of the settlement (Miksicek, 1991: 73). The development of these stratified societies marked the beginning of a remarkable trajectory that culminated in the emergence of first the Olmec and then the Maya polities, their burgeoning populations sustained by combinations of dry farming, swiddening, and swamp drainage, activities that register in the pollen diagrams as massive transformations to the landscape (Islebe *et al.*, 1996).

'DOORYARD HORTICULTURE' IN TROPICAL SOUTH AMERICA

The onset of the Holocene in South America seems not to have been characterized by climatic oscillations to the same degree as further north. A colder oscillation equivalent to the Younger Dryas of northern latitudes has not been detected south of Guatemala, perhaps because the more intense monsoonal activity buffered the southern continent from climatic reversals (Leyden, 1995). There was a sudden transition to the Holocene: temperatures rose fast and steeply to near modern levels, much of the change probably happening in as short a time as a hundred years (Piperno and Pearsall, 1998: 104–5). The result was very rapid afforestation that dramatically reduced the diversity and abundance of attractive open-land food resources for foragers. As in the case of Central America, Piperno and Pearsall (1998) argue that early Holocene foragers in the tropical parts of South America would inevitably have started to broaden their diet to include less attractive but more easily available foods. They suggest that there were probably at least half a dozen regions within the northern part of South America (from Colombia and Venezuela to Peru, Bolivia, and the Amazon basin in Brazil) where plants were taken into cultivation in the early Holocene and ultimately domesticated (Table 7.1; Fig. 7.11). The archaeological evidence from Colombia, Ecuador, and Peru is certainly persuasive that the strategies developed by foragers for living in the Holocene forests included, from the outset, a variety of horticultural practices.

On the tropical coast of Ecuador, for example, foragers on the Santa Elena peninsula combined broad-spectrum hunting (of deer, peccary, and smaller game such as fox, squirrel, and rabbit), with collecting shellfish, and gathering plants (Pearsall, 1995; Stothert, 1992). The skeletal record confirms the picture of a varied and healthy diet (Ubelaker, 1984, 1988). The size of the squash phytoliths indicates that the plants were of domestic status from the very beginning of the Holocene, suggesting that 'dooryard horticulture' is of similar antiquity here to in Central America (Piperno and Stothert, 2003). There are similar indications of horticulture being combined with foraging from very early in the Holocene at San Isidro on the edge of the Cordilleras (the northern Andes) in south-west Colombia. Here, a foraging group c.8000 BC combined hunting with collecting *Acrocomia* palm kernels and avocado seeds, using edge-ground cobbles on which were found starch grains of legumes, grasses, and tubers such as arrowroot. Furthermore, they were not only processing a wide variety of plant foods, but possibly also selecting, tending, and manipulating some of them: the avocado seeds were medium-sized, in part overlapping with the size of the modern domesticated avocado; the local vegetation was being disturbed by small-scale clearances;

and the lithic assemblage included a waisted hoe presumed to be for tilling soil (Piperno and Pearsall, 1998: 200–1). Contemporary sites in the Cauca valley like Sauzalito and El Recreo have grinding stones and hoes associated with remains of plants such as palms and avocados (Salgado López, 1989). In the Magdalena valley, clearances and maize pollen at Paramó da Peña Negra date to c.6000 bc (Kuhry, 1988).

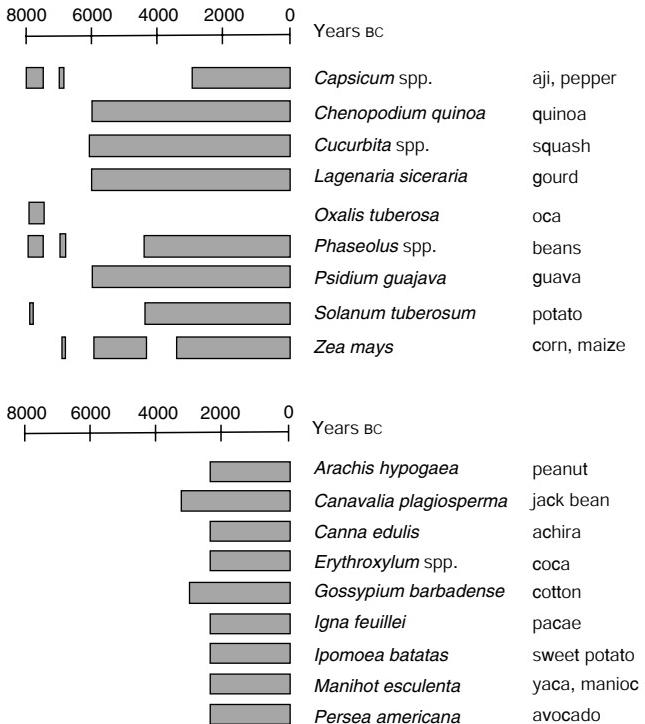
A series of spring-side forager camps in the Zaña valley in northern Peru dating to the early Holocene has yielded a variety of botanical indicators (desiccated and carbonized remains, starch grains) for the processing and consumption of manioc, peanut, quinoa, squash, and tree and cactus fruits (Dillehay *et al.*, 1989; Rossen *et al.*, 1996). Flakes have microwear damage from their use as harvesting tools, and dental evidence suggests a heavy use of plant foods. Several sites are associated with furrows and ditches thought to be conduits for taking water from the springs to cultivated gardens.

In the upper Amazon basin, the seventh-millennium BC site of Peña Roja in Colombia has produced evidence for *Oenocarpus* palms, tropical fruits, bottle gourd, leren, and squash, the size of the latter resembling that of modern domesticated varieties (Cavelier *et al.*, 1995). In contrast, in the lower Amazon basin, where vegetation is thought to have been densest, the food remains from the Caverna da Pedra Pintada and Taperinha nearby indicate a reliance on fish, turtles, and shellfish. The pottery that was manufactured at an early date here was probably developed to help with the storage and cooking of these foods (Roosevelt *et al.*, 1991, 1996).

In short, the indications are that by about 6000 BC, early Holocene foraging populations in the tropical regions of South America were practising increasingly ‘interventionist’ strategies of plant use including forest clearance, ground preparation, plant-tending, and in one instance even small-scale irrigation. These strategies were developed alongside mobile systems of hunting and gathering. Hunting still provided the main protein, though the latter would also have come from oil-rich squashes and avocado. The first plants selected for horticulture seem to have been tubers rather than seed plants. The tubers could have been prepared for eating by wrapping in leaves and baking in fire pits, whereas seed plants would have been more costly to process and probably also more complicated to cook without pottery vessels. Over the next three or four millennia this ‘dooryard horticulture’ developed into more systematic horticulture based on swiddening, though still practised alongside foraging.

Crops for which there is widespread evidence for their cultivation between 6000 and 2000 BC include a variety of roots and tubers (quinoa, potato), vegetables (squash, bottle gourd), legumes (beans), tree fruits (guava), maize, and chilli peppers (Fig. 7.13). Maize phytoliths at a site of the Vegas culture dated to about 6000 BC implied that domestic maize might have arrived in coastal

Fig. 7.13. (above)
Early and (below)
late cultivars in
South America
(after Pearsall,
1992: figs. 9.4
and 9.5)



Ecuador virtually at the time it was domesticated in Mexico, but this antiquity was disputed by Staller and Thompson (2002) on the evidence of AMS-dated maize phytoliths in sherds from the Valdivia site of La Emerenciana. They argued from the latter that maize only reached coastal Ecuador about 2000 BC, and was then valued more for its fermentation qualities than as a staple food. Regarding the dating, however, Pearsall (2002) and Piperno (2003) in their rejoinders pointed out that AMS dating now places the Vegas maize phytoliths definitely early (*c.*5000 BC) and restate the robustness of their identification methodologies, whilst also pointing out that maize phytoliths were also found in pre-2000 BC sherds at La Emerenciana. Maize cob phytoliths and starch grains have now been isolated on numerous grinding stones found associated with intact house floors at several sites in south-west Ecuador (Pearsall *et al.*, 2003, 2004). It does seem incontrovertible that maize was in the region significantly earlier than 2000 BC, probably nearer 5000 BC as Piperno and Pearsall argue, and that it was being cultivated, though probably not first primarily as a food staple: Smalley and Blake (2003) make a good case for its initial use as an alcoholic beverage.

As in Central America, a long phase of forest foraging-cum-horticulture was eventually followed by what seems commonly to have been a rather sudden commitment to farming in several regions, mostly in the context of dramatic cultural transformations (termed the Formative period again). In the Zaña valley in northern Peru, for example, there were permanent settlements by c.4500–3000 BC, including large ceremonial centres, their populations sustained by the cultivation of tubers, squashes, and legumes (Dillehay *et al.*, 1989; Rossen *et al.*, 1996; Table 7.2). The specialized production of lime at the centres may be linked with chewing coca leaves (the lime releases the coca's stimulants), perhaps as part of communal rituals (Piperno and Pearsall, 1998: 266). There was a similar trajectory of population increase and social stratification in lowland Ecuador, where there were sedentary and socially differentiated farming communities by 3500–1500 BC (Lathrap *et al.*, 1975). Their subsistence system was based on a mixture of permanent-field farming and foraging. A range of tuber, seed, and tree crops was cultivated, together with cotton. The diet was high in starch from foods such as manioc and achira (van der Merwe *et al.*, 1993; Ubelaker, 1998), with most protein coming from game such as white-tailed deer, shellfish, and fish (K. Byrd, 1996). Real Alto, which began as a collection of pole and thatch houses set around a central plaza, by 2000 BC was a large and socially stratified settlement of 2,000–3,000 people with ceremonial mounds and high-status tombs, its position amongst a cluster of smaller settlements suggesting that it may have been their administrative centre. One of the richest tombs has mortars and grinding stones, and given the evidence of the isotope studies that little maize was eaten in the diet, it is possible that maize at this time was a highly valued status food or drink (Raymond, 1993). Similarly, Staller and Thompson (2002: 47) cite the use of maize cobs to decorate pottery at La Emerenciana as evidence that 'maize was initially a sacred plant, its primary consumption in the form of a fermented intoxicant'. By the late Formative in the first millennium BC, though, maize was certainly the staple food.

In the tropical regions north and east of Ecuador and Peru, the combination of foraging and swiddening remained a successful strategy for many millennia. In north-east Venezuela and Trinidad, shell-collecting, fishing, hunting, and plant gathering were only gradually supplanted by horticulture. Pollen of maize and tubers (*Zamia debilis* and *Clausea rosa*) appears in the mid-second millennium BC (Sanoja, 1989). In the Cauca valley in Colombia, there is pollen and phytolith evidence that swiddening, including probably for maize cultivation, was practised until sedentary villages finally developed c.1000 BC based on the cultivation of maize, beans, and squash (Bray *et al.*, 1987; Monsalve, 1985; Table 7.1). On the eastern side of the Cordilleras in the Caquetá valley, manioc and maize were being cultivated in small-scale swiddens at Abeja and

Table 7.2. Plant remains from some Formative sites in the tropical lowlands of South America

Region and date BC					
Zaña Peru (4500–3000)	Valdivia Ecuador (3500–1500)	Machalilla Ecuador (1500–700)	Chorrera Ecuador (700–0)	Caquetá Colombia (2700–0)	Cauca valley Columbia (1000–0)
<i>Roots and tubers</i>					
Leren					
Arrowroot		Ph.			Ph.
Achira		Ph.	Ph.	Ph.	
Yuca	M				P
<i>Vegetables</i>					
Squash	M	Ph.		Ph.	Ph.
<i>Grains</i>					
Maize		Ph.	Ph. M	Ph. M	P
Quinoa	M				Ph. M
<i>Legumes</i>					
Jack bean		M	M		
Peanut	M				
Common bean				M	M
<i>Industrial</i>					
Bottle gourd		M			
Cotton	M	M			
<i>Stimulants</i>					
Coca	M				
<i>Tree fruits</i>					
Palms		M Ph.		Ph.	M Ph.
Soursop		M			
Sapotes		M			

Notes: M = macrobotanical; Ph. = phytolith; P = pollen.

Source: Piperno and Pearsall, 1998: 248–9.

Araracuara in the third millennium BC, with no signs of intensification until the first millennium AD (Herrera *et al.*, 1992; Mora *et al.*, 1991). Maize and squash swidden farming is recorded from c.3000 BC to the end of the first millennium BC in the Lake Ayauch pollen diagram in the Ecuadorian Amazon (Bush *et al.*, 1989; Pearsall, 2002). In the main Amazon basin, on the evidence of pollen diagrams from Lake Geral and near Manaus (Piperno and Becker, 1996), foraging remained pre-eminent, combined with long-fallow cultivation systems—maize played little if any role in subsistence until the development of chiefdoms in some parts of the basin shortly before the period of European contact (Myers, 1992; Roosevelt, 1987). Another region that witnessed the late development of chiefdoms was the *llanos* of western Venezuela, where a three-level settlement hierarchy developed in the mid-first millennium AD sustained by maize-based farming in fields from which excess water was drained by an elaborate network of canals into the tributaries of the Rio Canagúa (Spencer, 1994; Spencer and Redmond, 1992).

MARINE-BASED FORAGING ON THE PACIFIC COAST

Beyond the tropical regions, early Holocene foragers depended much less on plant foods, and on the arid Peruvian coast, people relied almost exclusively on marine foods (Chauchat, 1988). The wealth of the marine foods here in time underpinned the development of village-based societies comparable in many respects to Formative agricultural villages in the tropical regions (Moseley, 1975, 1992). People living in permanent settlements at Paloma and Chilca c.4000 BC hunted sea mammals, fished, and collected shellfish. Isotope studies of their skeletons show that they depended on these marine foods as their staples. They also hunted animals inland and practised small-scale horticulture, growing achira, jacima, squash, guava, lima bean, jack bean, bottle gourd, and cotton, plants that were probably acquired in exchange systems with communities in adjacent tropical regions (Benfer *et al.*, 1987; Piperno and Pearsall, 1998: 274–5; Weir *et al.*, 1988). By 2500–1500 BC the fishing-hunting-horticulture mix sustained substantial centres up to 50 hectares in size with ceremonial architecture such as La Galgada, Huaca Prieta, El Paraiso, and Las Haldas (Bird *et al.*, 1985; Grieder *et al.*, 1988; Pozorski and Pozorski, 1987, 1992; Quilter *et al.*, 1991). The botanical record from these sites includes, in addition to the crops grown earlier, new roots and tubers (yuca, sweet potato, potato), tree fruits (avocado, soursop, lucuma, pacay, ciruela), and legumes (peanut, common bean) (Piperno and Pearsall, 1998: 274–5; Fig. 7.13). It is not clear how many of these were cultivated, though, as there is much evidence for exchange systems between the coastal communities and inland (where

agriculture was certainly practised by this time). However, the large central storage facilities of the major centres make it clear that the control of the food supply was a critical feature of elite power. At Pampa de las Llamas-Moxeke, for example, two large mounds formed the focus of the settlement, one of them (Huaca A) supporting a huge building made of cells each with barred entrances to restrict access. Its role as a food store is suggested by thousands of rodent bones, together with pollen of cultigens such as peanut, bean, potato, sweet potato, and avocado (Pozorski and Pozorski, 1992).

These coastal settlements are in regions of zero rainfall, so it is assumed that simple systems of irrigation must have been developed, to divert water from rivers into garden plots. Irrigation agriculture probably sustained the large and complex settlement of Caral, for example (Shady Solis *et al.*, 2001). The physical evidence for canalization is largely circumstantial (a present-day irrigation canal by the site is taken to be evidence for the likelihood of a prehistoric one on the same alignment), but given the lack of an arable floodplain the wealth of plants recovered—squash, beans, lucuma, guava, pacay, camote, and cotton—strongly implies that effective irrigation systems must have been in place. Irrigation systems were certainly constructed on the coast in the Chavín period in the first millennium BC, when maize was widely cultivated. However, isotope studies show that marine food remained the staple, with maize eaten only on a small scale, perhaps as a high-status ritual food (Burger and van der Merwe, 1990; Ericson *et al.*, 1989; Pozorski, 1983). The impression from the skeletal studies is that health was extremely poor, with high childhood mortality and diseases such as syphilis endemic. One thesis is that these coastal populations had to turn increasingly to plant husbandry, despite the difficulties of practising it in such an arid environment, because the development of the El Niño phenomenon after about 3000 BC meant there were high risks of the marine economy collapsing every few years as warmer nutrient-poor water moved south down the coasts of Ecuador and Peru (Rollins *et al.*, 1986; Sandweiss *et al.*, 1996). The same weather changes would also have brought torrential rains, another context perhaps for the development of water-diversion channels (Moseley, 1992).

TRANSITIONS TO FARMING IN THE ANDES

By the early Holocene, the Andes sustained populations of mobile foragers (Rick, 1980). The main emphasis at Panalaucá near Lake Junín and sites in the Ayacucho basin was on dry-season hunting of deer and camelids and wet-season trapping of small game such as guinea pigs, along with collecting various berries and grass seeds (MacNeish, 1977; Wheeler *et al.*, 1976; Wing,

1978). The development of plant husbandry in the high Andes seems to have been closely related to animal domestication (Browman, 1989; Pearsall, 1989). Camelid bones made up a quarter of the early Holocene faunal sample at Panalaucá, but they dominated the sample completely in the levels dating to c.5500–2500 BC (Wheeler *et al.*, 1976). This was also the case at the contemporary site of Telemachay (Wheeler, 1984). Clearly camelids were being subjected to increasingly intensive exploitation at this time, and morphological changes (bone size and incisor shape) imply the development of at least herd management and perhaps selective breeding. Pearsall (1989) suggests that coralling llamas would have created manure-rich disturbed habitats conducive to weedy plants such as *Chenopodium*, the wild ancestor of quinoa (*Chenopodium quinoa*), and *Lepidium*, the ancestor of the cold-tolerant crop maca (*Lepidium meyenii*). Significantly, she notes, the indicators of llama domestication at Panalaucá coincide with the development there of shorter, rounder, *Lepidium* roots that are probably indicative of plant tending and deliberate selection. At Tres Ventanas in Peru, too, camelid domestication coincides with the occurrence of primitive forms of potatoes (AMS-dated to c.5000 BC) and yams, though their status (whether wild or domesticated) is uncertain. In the Ayacucho basin to the south, the development of animal pastoralism seems to have been more protracted, the herding of domestic llamas probably not developing before the second millennium BC (MacNeish, 1977). In the Atacama desert, desiccated fibres at Puripica and Tulán indicate the presence of llamas with the modern domesticated coat, as well as of animals with coats like those of modern wild camelids, by about 1000 BC (Dransart, 1991). Guinea pigs were probably tamed in the Andean lowlands at an early date, but increased size is only noted by c.1500–1000 BC (Wing, 1978).

By the period of the Incas, most of the crops listed in Table 7.1 were being widely cultivated throughout their empire, with maize critical in the lowlands, tubers and quinoa in the Andes and, probably, manioc in the Amazonian lowlands. The impact of conquest on the social relations of agricultural production was elegantly studied by Hastorf (1988, 1991) in the case of one community: Tunanmarca in the upper Mantaro valley in central Peru. Detailed studies of the distribution of food residues within household structures indicated that people kept guinea pigs in their kitchens (dropping leftovers for them), and used their patios for storing fuel and animal fodder and for cleaning, winnowing, and sorting crops. From the early first millennium AD to the Inca conquest in AD 1460, the community's agricultural system was based on the cultivation of quinoa, tubers such as potato, and legumes, with maize of little importance. Camelid meat was also eaten. The food remains show a marked increase in maize after the conquest, and skeleton isotopic studies demonstrate that this was largely in the male diet (Fig. 7.14). The Inca

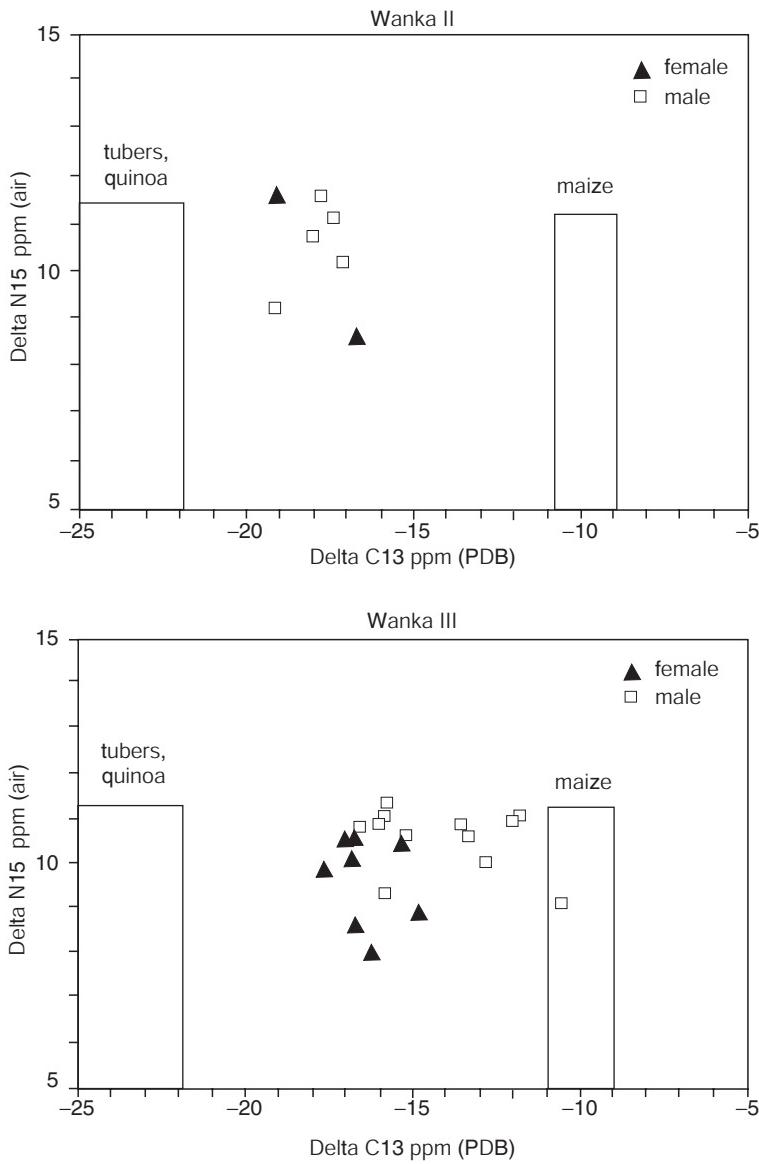


Fig. 7.14. Carbon (Delta C13) and nitrogen (Delta N15) isotopic values for skeletons from Wanka, Tunanmarca, Mantaro valley, Peru, showing the shift in diet from Phase II to Phase III as the region became part of the Inca state: maize became more important, especially for men, the latter probably a result of ceremonial drinking of maize beer (*chicha*) and rations given to men in return for agricultural and military service (*mit'a*); ppm—parts per million; PDB—pee dee belemnite, the standard against which the delta scale is calibrated (after Hastorf, 1991: figs. 5.5 and 5.6)

made the males in their subject populations contribute their labour, either in military service or agricultural works, in return for maize rations. Also, the communal consumption of maize beer (*chicha*) was an increasingly important part of male ceremonial activities. The impact of imperialism, though, was not simply in terms of changing diet and relations to the external authority. Within the Tunanmarca community, the status of women deteriorated as they were increasingly restricted to an array of household activities much as in the traditional communities of the region today: planting, hoeing, weeding, watering, harvesting, processing, cooking and brewing, as well as weaving, spinning, and child-rearing.

CONCLUSION

The initial work on transitions to farming in the Americas concentrated on the dryland regions of the South-West United States, Mexico, and Peru, where there was a good chance of recovering desiccated and carbonized plant remains. The results suggested that plant domestication probably began independently in Central America and Peru, and possibly also in the South-West United States, with maize being domesticated first in the highlands of Central America before being adopted by farmers to the north and south. Little was understood about when and how root and tuber crops might have been cultivated, though Lathrap (1977) postulated that manioc was probably domesticated somewhere around 3000–2000 BC in Colombia and the Amazon basin and was then taken by farmer-colonists northwards to tropical Central America and westwards to Peru. The past two decades of research have utterly changed this picture.

In the major river valleys of central and eastern North America, for example, foragers were engaging in the cultivation of weedy plants like marsh elder, sunflower, and squash by 5000 BC. Although the direct dating of maize cobs by AMS dating has shown that maize domestication began much later in the arid regions than at first thought, highland populations were certainly cultivating other crops from very early in the Holocene, probably including the agave cactus or maguey. In the tropical regions of Central and South America, forest horticultural practices began very early in the Holocene, focusing variously on roots and tubers such as arrowroot, manioc, yam, and squashes, together with maize. Whatever the reason or reasons for the development of plant cultivation, a wide variety of plants was being manipulated and taken under control by foragers throughout the Americas from the very beginning of the Holocene. The marked differences between North, Central, and South American varieties of maize have been taken to imply multiple domestications (Bonavia and

Grobman, 1989; B. Pickersgill, 1989; Pickersgill and Heiser, 1977), but the molecular evidence currently indicates a single domestication event probably on the western lowlands of Mexico, the location today of the most maize-like wild teosinte. The separation between teosinte and maize occurred around 6000 bc (Matsuoka *et al.*, 2002), with its ensuing adaptation to very different environments in the course of its remarkable dispersal northwards and southwards accounting for the tremendous diversity found in the plant today.

Yet people everywhere continued to rely predominantly on foraging for their food for thousands of years. In the temperate and arid regions they combined various forms of foraging with riverside gardens, and in the tropical forests with swiddening. In the eastern Woodlands, sedentary, socially differentiated, societies developed on the basis of mixed foraging and farming, and there were comparable societies in areas of particularly plentiful marine foods such as coastal North America. The most dramatic transformations, though, took place in parts of Central and South America variously between c.3500 and 1500 bc. There were rapid shifts from low-density, small-scale, clan-based societies living by foraging and farming to what can broadly be characterized as populous competitive chiefdoms based on the cultivation of a few staple crops (Brumfiel and Fox, 1994).

Maize farming did not intrinsically provide more food or a more stable subsistence than foraging. An important factor in its adoption as a staple was often the availability of high-ranked wild foods, not harvest yields *per se* (Barlow, 2002). As with rice in South-East Asia, for some societies it may well have been valued first as a status crop, perhaps for brewing beer, but in time it developed as the staple food for most of the Formative polities in Central and South America, the burgeoning rural populations of the pre-Columbian states, and hierarchically based societies like the Anasazi in North America. The demands of maize farming stimulated a variety of ingenious responses by indigenous American farmers. Where there was too much water, they constructed canal-drained fields (such as in the Amazon basin) and ridged fields (in the northern temperate zone); where there was too little, they responded with a suite of canalization, floodwater-farming, and terracing methods.

Africa: Afro-Asiatic Pastoralists and Bantu Farmers?

INTRODUCTION

Africa, the cradle of humankind several million years ago, was also where anatomically modern humans first developed over 150,000 years ago. Yet our understanding of how these people eventually became farmers is still very limited. A generation ago Thurston Shaw commented that, in comparison with other parts of the world, ‘Africa lags behind...in relation to archaeological research and in knowledge about the beginnings of food production’ (Shaw, 1977: 108). Ann Stahl’s review of the topic a few years later made the same observation: ‘research into the origins of African agriculture lags ten to fifteen years behind studies of early agriculture elsewhere’ (Stahl, 1984: 19). In many regions, archaeologists in the 1970s and 1980s were still attempting to establish the most basic chronological framework of artefactual sequences, let alone recover the biological remains that could show when agricultural activities began (Hall, 1996). Many parts of the continent have endured decades of political unrest and military conflict, making archaeological fieldwork impossible for long periods. The equatorial forests are particularly under-researched because of the combination of political unrest, the difficulties of conducting fieldwork in forest, and poor preservation conditions of organic remains. Our understanding of the archaeological history of human settlement in these vast regions is still extremely rudimentary. For countries grappling with tremendous problems of underdevelopment, funding archaeologists in museums and universities can inevitably be a low priority. The number of professional archaeologists engaged in fieldwork on the African continent, indigenous Africans especially, is still extremely small. Distribution maps of archaeological sites are often primarily an indication of where archaeologists have been able to work. Despite these considerable challenges, however, recent studies have started to transform long-standing ideas about when, how, and why people in Africa started to practise plant and animal husbandry (Fig. 8.1).

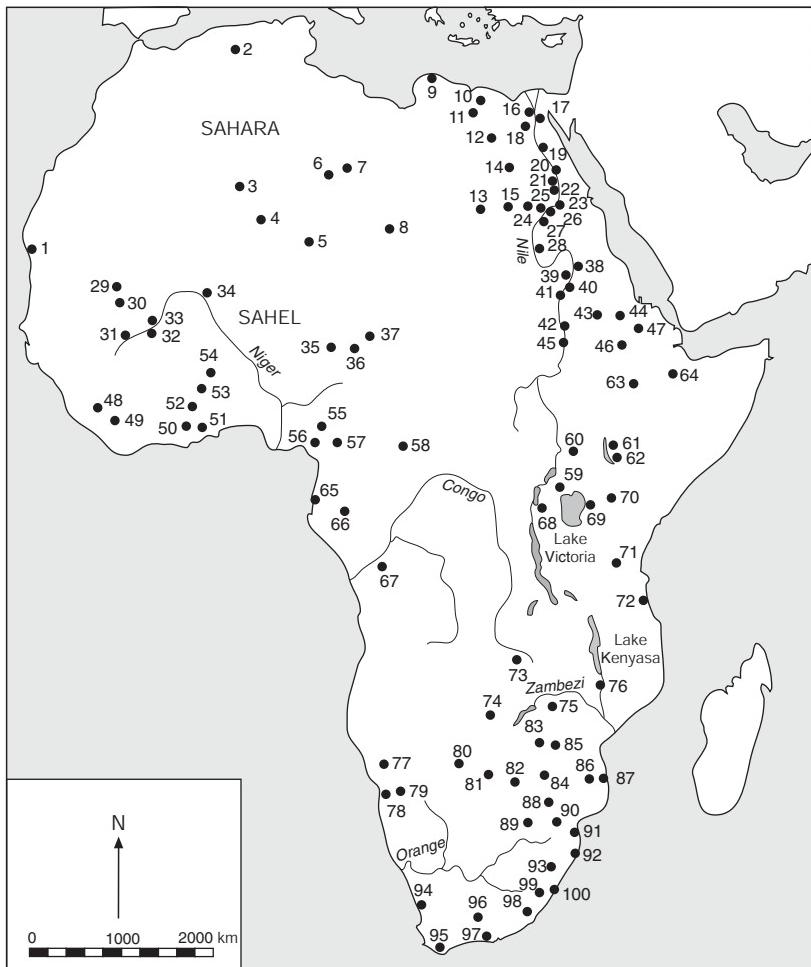


Fig. 8.1. Africa, showing the principal regions and sites mentioned in Chapter 8.

Sites: 1. Chami; 2. Grotte Capelletti; 3. Meniet; 4. Amekni; 5. Adrar Bous, Talagalal, Tin-Ouaffadene; 6. Tadrart Acacus, Libya—Ti-n-Torha, Uan Afuda, Uan Muhuggiag; 7. Germa; 8. Bardagué; 9. Haua Fteah; 10. Gara oasis; 11. Siwa oasis; 12. Farafra oasis; 13. Gilf Kebir; 14. Dakhlar oasis; 15. Bir Kiseiba; 16. Merimde; 17. El Omari; 18. Fayum depression; 19. Badari, Hemamieh; 20. Komombo; 21. Wadi Kubbaniya; 22. Afyeh; 23. Qasr Ibrim; 24. Nabta Playa; 25. Tushka; 26. Catfish Cave; 27. Jebel Sahaba; 28. Kerma; 29. Dhar Tichitt; 30. Oued Chebi; 31. Kourounkorokale; 32. Jenne-jeno; 33. Dia; 34. Karkarichinkat; 35. Dufuna; 36. Daima; 37. Mdaga; 38. Aneibis, Abu Darbein, El Damer; 39. Esh Shaheinab; 40. Saggai I, Kababbashi; 41. Kadero, Khartoum, Sarurab; 42. Tagra; 43. Khashm el Girba; 44. Godebra; 45. Jebel Moya; 46. Lalibela; 47. Axum; 48. Kokasu; 49. Sopie; 50. Lake Bosumtwi; 51. Bosumpra; 52. Kintampo; 53. Ntereso; 54. Birimi; 55. Bamenda, Shum Laka; 56. Nkang; 57. Obobogo; 58. Batalimo; 59. Nfusi; 60. Apeget, Namoratunga; 61. Lake Turkana, Koobi Fora; 62. Lowasera; 63. Lake Besaka; 64. Laga Oda; 65. Okala; 66. Middle Ogooué valley; 67. Ngovo, Sakuzi; 68. Rukiga highlands; 69. Gogo Falls; 70. Prolonged Drift; 71. Dakawa; 72. Kilwa; 73. Luano; 74. Chundu; 75. Kadzii; 76. Matope Court; 77. Hungorob ravine; 78. !Khuisib delta; 79. Mirabib; 80. Nxai Nxai; 81. Hippo Tooth; 82. Toutswe; 83. Mabveni; 84. Mapungubwe, Schroda; 85. Great Zimbabwe; 86. Manekwini; 87. Chibue; 88. Silver Leaves; 89. Broederstroom; 90. Lyndenburg; 91. Matola; 92. Enkwazini; 93. Mamba, Ndondondwane; 94. Elands Bay Cave; 95. Die Kelders; 96. Boomplaas; 97. Klasies River Mouth; 98. Ntsitsana; 99. Sehonghong; 100. Mzonjani

The northern margins of the continent are Mediterranean in climate and environment, and the beginnings of farming there are best understood as part of the wider settlement history of the Mediterranean basin discussed in the next chapter. The Saharan desert in places reaches right to the coast, for example at Libya's Gulf of Sirte, but elsewhere the Mediterranean zone can be up to 200 kilometres deep, notably in the mountainous region known as the Maghreb that embraces much of Morocco, northern Algeria, and northern Tunisia. The Sahara is the largest arid zone in the world, extending some 2,000 kilometres north-south and 5,000 kilometres from the Atlantic coast of Mauritania to the Red Sea. Although there are many zones of sand seas (*ergs*), the classic landscape of films like *Beau Geste* and *Ice Cold in Alex*, much of the Sahara consists of gravel and rock desert. There are also many upland massifs in the Sahara such as the Hoggar (Algeria), Adrar des Iforas (Mali), Air (Niger), Tibesti (Chad), Tadrart Acacus (Libya), and Gilf Kebir (Egypt). Leaving aside oil encampments, the Sahara only supports permanent settlements and farming in oases and, of course, along the greatest agricultural resource of North Africa, the rich, annually replenished, silts of the Nile valley.

From about 20 degrees (roughly the southernmost borders of Algeria and Libya, and some 200 kilometres south of Egypt's border with Sudan), rainfall starts to increase with latitude southwards, resulting in successive bands of increasingly dense vegetation. The first is called the Sahel or sahelian zone, a landscape of semi-desert scrub and seasonal grassland that receives some 100–400 millimetres of annual rainfall. This is succeeded by grassland-dominated savannah, with an annual rainfall of 400–1,000 millimetres, and then by mixed savannah-woodland where annual rainfall exceeds 1,000 millimetres. In this chapter, though, as commonly in discussions of African archaeology, the term Sahel is used as a convenient term to describe the semi-arid lands of sahel, savannah, and mixed savannah-woodland lying between the Sahara, the tropical rainforests of West Africa, and the interlacustrine region centred on Lake Victoria.

The tropical rainforests begin along the coast of West Africa where the rainfall is over 1,500 millimetres, and extend southwards into the Congo-Zaire basin. This vast basin covers some 400,000 square kilometres, is mostly of gentle relief (20–40 metres above sea level), and at the equator receives almost 2,000 millimetres of rain each year. The interlacustrine region receives between about 750 and 1,500 millimetres, and is also heavily forested. Most of East and Central Africa has sufficient rainfall to support savannah vegetation. The central and western parts of South Africa (used throughout this chapter as a general geographical term, not in reference to the modern Republic of South Africa) are increasingly arid, with semi-desert in most parts and two desert regions, the Kalahari centred on south-west Botswana and the Namib

along the coast of Namibia. The Cape is an island of green in the arid ochres and yellows of the South African landscape, its Mediterranean-style climate producing a unique flora and fauna.

Many parts of the African landscape, therefore, present profound challenges to farmers. The most severe obstacle is the lack of water, not simply in deserts but in the many semi-arid regions where rainfall is meagre and unreliable. Studies of historical rainfall records make it clear that, quite apart from any long-term trends in weather patterns, the African climate has been characterized by complex rainfall cycles operating at the level of decades and centuries (Nicholson, 1980). The dramatic short-term fluctuations caused by this regime regularly devastate crops and pasture, and the livelihoods of the people dependent on them. Many regions have thin soils that are poor in nutrients and easily degraded, others have heavy soils that are hard to cultivate especially with simple hand tools. Livestock herders have to contend with problems such as the tsetse fly (*Glossina* sp.) that is endemic in moist woodland areas, which infects animals and people with *trypanosiamis*, sleeping sickness. Cattle are particularly vulnerable, though some of the traditional breeds are more resistant than others. Before modern insecticide programmes (only partially successful as many wild animals are also hosts to tsetse), herders had to develop strategies to cope such as clearing forest or moving their herds into tsetse-free areas for some parts of the year.

TRADITIONAL AGRICULTURE AND PASTORALISM

The challenges and opportunities of Africa's landscapes have promoted a great diversity of traditional land use systems, though with European colonialism and the subsequent development of the global economy the most favoured regions have been transformed by cash-crop farming. As Boserup (1965) pointed out, traditional African farming operates at a variety of scales of intensity of effort and reward. At one extreme are cropping regimes in which several crops a year can be produced by practices such as irrigation and manuring. At the other, the land is just cropped for a few years and then left fallow for a generation. More common are intermediate systems such as short-fallow swiddening, where land is left fallow for a few years, or cropping systems in which one crop can be taken in alternate years after a fallow year, or annual cropping.

The Mediterranean coast, with more than 200 millimetres of annual rainfall, supports the classic Mediterranean mixes of olives, vines, wheat, and barley. The Nile silts sustain intensive cropping systems geared to the annual flooding cycle. The headwaters rise in the spring, with the main floods in

the lower Nile lasting through the summer. In many Saharan oases, water supplies were enhanced by digging not just wells but also horizontal shafts (*foggaras*, like the *qanats* of the Middle East) to tap into underground water from surrounding slopes. Though wheat and barley thrive in the lower Nile valley, the traditional cereal staples of the populations living in the Nile valley, the Saharan oases, and the Sahel have been sorghum, pearl or bulrush millet (the most drought-resistant of the millets), and finger millet, the latter valued especially for beer-making. Other common Sahel crops are Guinea millet (*Brachiaria deflexa*), African rice (*Oryza glaberrima*), and fonio (*Digitaria exilis*). The latter is sometimes referred to as 'hungry rice', though it is in fact highly valued for couscous (Harlan, 1993). Of the sorghums, *Sorghum bicolor* is the most widespread, but there are several major varieties adapted to distinct regions: *S. durra* in the Nile, *S. caudatum* in the Sahara, *S. guinea* in West Africa, and *S. kafir* in South Africa (Harlan and Stemler, 1976). Ethiopia is unusual in having two local staples, teff (*Eragrostis tef*) and ensete (*Ensete ventricosum*), a variety of banana grown for its edible stalk. In the tropical regions, the major staples have been yams, manioc, and plantains, though the latter two are not indigenous. Manioc is known to have been introduced from America, but when plantains (*Musa × paradisiaca*) and crops like the banana (*Musa × sapientum*) arrived is less certain (banana phytoliths have been identified in pottery from Cameroon of the first millennium BC: p. 313).

Many of the semi-arid regions of Africa support people who are still largely or entirely dependent on pastoralism, though trading with farmers for goods they need. The semi-arid regions between the Mediterranean littoral and the Sahara were traditionally inhabited by transhumant pastoralists who combined the herding of sheep, goats, and camels with small-scale cultivation of wadi floors inundated by seasonal rains. The people moved further into the desert in the winter, sowing as they moved, returning to the semi-arid pre-desert in the spring and harvesting the crops en route, a pattern of movement described for the indigenous peoples inland from the Greek colony of Cyrene in north-east Libya by the fifth-century BC historian Herodotus. The most arid regions of the Sahara can only support camel pastoralists such as the Tuareg (Nicolaisen, 1963). Large areas of the Sahel are used primarily by cattle-keeping pastoralists such as the Nuer, famously studied by Evans-Pritchard (1940).

There are similar pastoral societies on the savannahs of East Africa such as the Masai, though it is important to remember that, whilst cattle are the principal medium of social relations, most 'cattle-keepers' keep sheep and goats and grow cereals such as millet as a staple food (Dyson-Hudson and Dyson-Hudson, 1969; S. Smith, 1980). The arid parts of South Africa were also conducive to pastoralism, and when the Dutch arrived at the Cape in

the sixteenth century, they came into contact with pastoral Khoikhoi societies in the hinterland who relied especially on herding sheep and goats. In the southern deserts small numbers of people have lived by foraging to very recent times, probably the best known to ethnographers (and archaeologists) being the Kalahari San. Today they are being drawn increasingly into the agricultural sphere, though without land or livestock they are rapidly becoming an under-class in client relationships to neighbouring Bantu farmers (Brooks *et al.*, 1984; Cashdan, 1984). Traditional Bantu farming combined the cultivation of crops such as sorghum and millet with stock-keeping. Sheep and goats were frequently the most important stock in terms of subsistence input, but cattle were usually valued highly as wealth on the hoof, to be accumulated for prestige, bridewealth, gift-giving, and so on.

CURRENT MODELS FOR THE SPREAD OF AGRICULTURE

For decades, the beginnings of farming in Africa have been explained in terms of migrations, with incoming farmers displacing existing populations of foragers or colonizing new, empty, land. In 1962 and 1964 J. D. Clark reviewed the evidence of the first radiocarbon dates in North Africa from 'Neolithic' or 'early farming' sites identified mainly on the basis of pottery, as few sites were associated with domestic cereals and livestock. He concluded that farmers with wheat, barley, sheep, and goats (all then regarded as not native to the region) must have migrated into Africa from South-West Asia, arriving at the Nile delta *c.*5000 bc. By *c.*4000 bc they had spread westwards into the Sahara (which was known to be wetter in the early Holocene than today), and southwards up the Nile valley to the Khartoum region by *c.*3000 bc. They then expanded into the Sahel by *c.*2000 bc. As an explanation for the spread, he suggested that desiccation in the Sahara would have pushed farmers southwards into the Sahel, an idea that has stayed firmly in the literature ever since (e.g. Clark, 1984a; Harlan, 1989a, 1992; T. Shaw, 1984; Stemler, 1980, 1984). There was virtually no archaeological evidence for when farming began in West Africa (Davies, 1968), but in Central and South Africa the first indications seemed to be in the first millennium ad, in association with evidence for the first pottery and iron working. Clark presumed that metal-working knowledge must have spread southwards from the Nile civilizations, along with knowledge of how to farm. He concluded that Iron Age farmers spread southwards down the central spine of the continent from the Sahel to the Cape during the first millennium ad.

Linguistic studies have played a major role in shaping archaeological thinking about transitions to farming in Africa. The languages of the continent



Fig. 8.2. The distribution of Africa's major language families (simplified after Greenberg, 1966)

have been classified into four major families on the basis of common lexical and grammatical elements (Greenberg, 1955, 1966): Afro-Asiatic in the north; Nilo-Saharan in the central Sahara and the upper Nile region; Niger-Congo over most of sub-Saharan Africa, the latter dominated by the Bantu languages; and Khoisan, the language of the San foragers (Fig. 8.2). Khoisan lacks words for crops, livestock, or agricultural activities, so was taken to indicate that it had always belonged to people who were foragers (Ehret, 1976). In contrast, the three other language groups are all characterized by a set of shared agricultural terms amongst their respective members (Ehret, 1984; Ehret and Posnansky, 1982). It has therefore been argued that the speakers of the original 'proto-languages' must have been acquainted with domestic crops and animals from the outset, so pinpointing where the languages first

developed would pinpoint the origins of the first farmers. For the Afro-Asiatic group, which includes languages such as Berber, Egyptian, Cushitic, and Chadic in North Africa and the Semitic languages of South-West Asia, linguists have variously favoured South-West Asia or North Africa as the focus of origin (Blench, 1993), Militarev (2002: 135) even going so far as to assert that Afro-Asiatic people in North Africa 'can be identified, with high probability, with the creators of the Natufian and Post-Natufian Early Neolithic archaeological culture of the Levant'. A South-West Asian origin, of course, chimed with archaeological thinking about the primacy of early agriculture there. In the case of the Bantu, Greenberg (1955) argued that, given that the greatest linguistic diversity is in the north-west of the present-day distribution, 'proto-Bantu' (and the first Bantu farming) probably first developed in the region of modern-day Nigeria and Cameroon. Guthrie (1962, 1967) proposed instead that proto-Bantu began south of the equatorial forests, in what is now northern Angola. Oliver (1966) attempted to combine both theories into an archaeological model for the spread of farming: people speaking proto-Bantu spread southwards from an original homeland in tropical West Africa to form a secondary nucleus south of the rainforests, and then moved out into East, Central, and South Africa taking the skills of pottery, metallurgy, and agriculture with them.

Ever since these language/people dispersal models were proposed, there have been complex debates about the precise location of language homelands and the possible relations between the different language groups (e.g. Blench, 1993, 1996; Ehret, 1967, 1968, 1971, 1972, 1973, 1984, 1993, 2002a, 2002b; Greenberg, 1966, 1972; Vansina, 1996). Archaeologists attempted to marry the archaeological record with these changing theories, including not just evidence of material culture and subsistence data but also skeletal types, attempting to link language groups with ethnic types (e.g. Huffman, 1970; Phillipson, 1975, 1976, 1977a, 1984, 1985; Philippson and Bahuchet, 1996; T. Shaw, 1976, 1977; Sutton, 1966). Though the details differed, a consensus emerged that farming must have started in most parts of Africa as a 'package' of new people, speaking a new language, with new technologies (pottery, and iron in the south) and a new way of life (agriculture). Afro-Asiatic farmers, it has been argued, spread first into the Nile valley from South-West Asia, some scholars arguing that the context for this was a climatic crisis c.6000 bc that forced many PPNB farmers to flee the Levant (Bar-Yosef and Meadow, 1995). They then colonized the Sahara and Sahel. Bantu farmers, it was agreed, must have acquired farming from them, and they then carried it (and iron) southwards as they in turn colonized West, East, and South Africa.

Theories about the pathways of Bantu expansion have varied, in part as scholars tried to marry the linguistic arguments with new archaeological

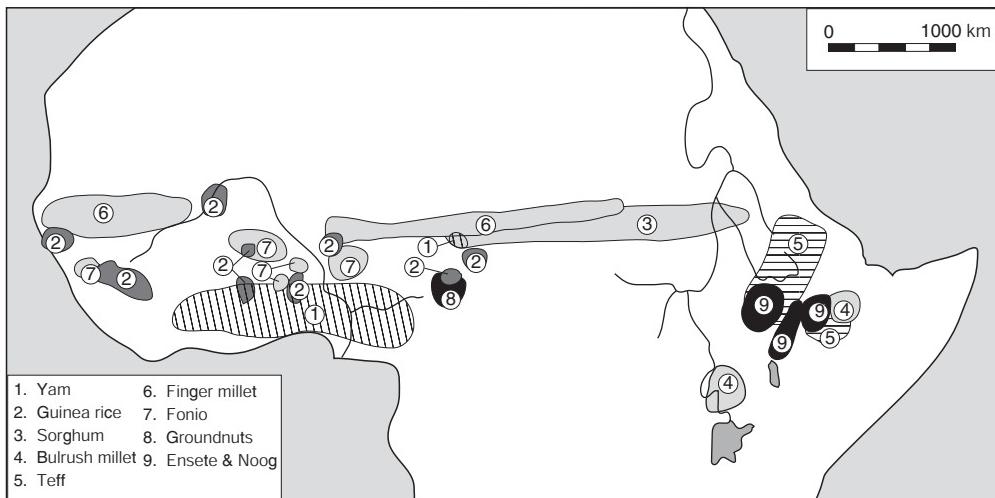


Fig. 8.3. Possible locations where indigenous African crops were first domesticated, proposed from modern plant botany and geography (after Harlan, 1971: fig. 6.1)

discoveries. Phillipson (1985), for example, proposed that proto-Bantu speakers dispersing eastwards along the northern edge of the tropical forests must have acquired pottery, metallurgy, sheep, cattle, and sorghum from Sudanic-speakers to the north, and then spread southwards in two main streams, one down the western side of the peninsula (via Guthrie's homeland), the other across to the east coast and then as a series of separate migrating groups down the eastern and central parts of the sub-continent. Ehret (1984) proposed an even more complex scheme: Proto-Cushites (Afro-Asiatics) domesticated sorghum, bulrush millet, cattle, sheep, and goats in the western Sahel; Proto-Central Sudanics (Nilo-Saharanans) did the same in the upper Nile; Proto-Bantu speakers domesticated yams in the Cameroon region; the Bantu then acquired different parts of the 'agricultural package' from Cushites who had expanded into Kenya, and then colonized Central and South Africa.

The other important approach to African agricultural history has been to model likely hearths of domestication on the basis of present-day distributions of domesticated crops and presumed wild progenitors (Harlan *et al.*, 1976; Fig. 8.3). Ever since the pioneering study of African ethnography and history by Murdock (1959), it has been commonly proposed that the root and tuber staples of tropical farming, in particular the white yam (*Dioscorea rotundata*) and the yellow yam (*Dioscorea cayenensis*), were probably domesticated independently in West Africa (Coursey, 1976; Shaw, 1984). Other candidates proposed for domestication alongside yams included oil palm (*Elaeis guineensis*),

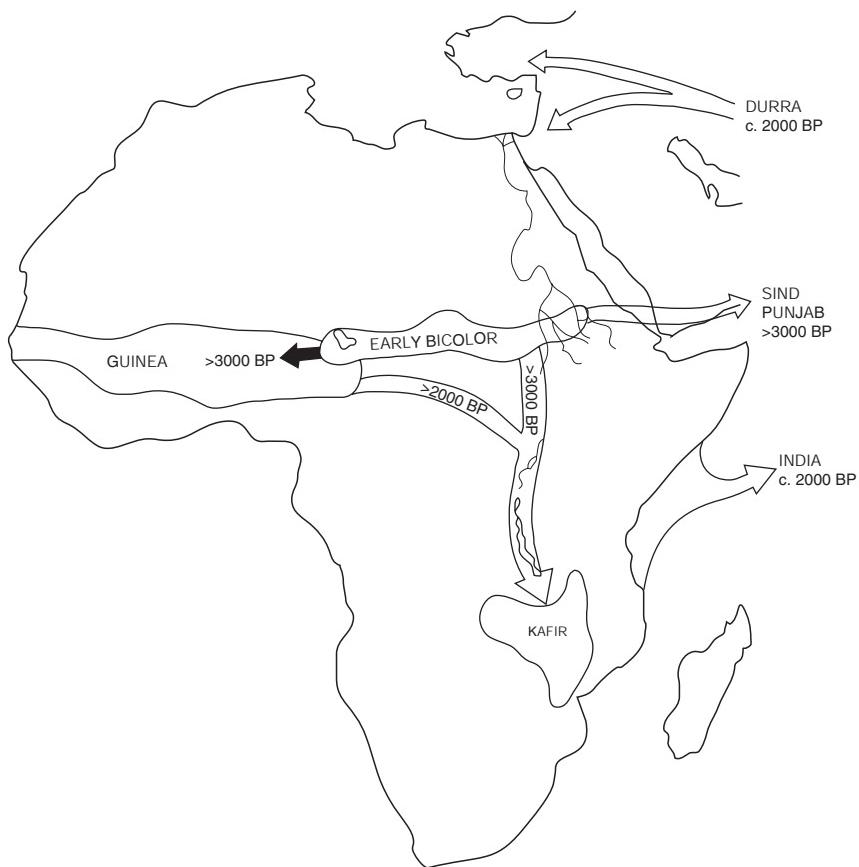


Fig. 8.4. The domestication and early movements of different types of sorghum (Bicolor, Guinea, Kafir, Durra), as proposed by Harlan and Stemler (after Harlan and Stemler, 1976: map 5)

groundnut (*Kerstingiella geocarpa*), and okra (*Abelmoschus esculentus*). Rice and fonio domestication was generally located in West Africa, millet domestication through the Sahel, and teff and ensete domestication in Ethiopia (Harlan, 1992, 1993; Portères, 1976). The sorghum most like the assumed wild progenitor (*Sorghum verticilliflorum*) is *Sorghum bicolor*, and Harlan and Stemler (1976) and Harlan (1989b, 1992, 1993) argued for a complex history of successive domestications and migrations (Fig. 8.4). They suggested that the plant was first domesticated in the eastern Sahel, then spread into the western Sahel where *S. guinea* was developed adapted to this ecology, and southwards to South Africa where *S. kafir* was developed. Meanwhile, *Sorghum bicolor* had travelled eastwards to the Red Sea and thence to India, and at a later date the domesticated *S. durra* race came back to North Africa via South-West

Asia. The chronology for these events was fixed largely with reference to dated sorghum remains in (broadly speaking) Harappan contexts in South Asia (Chapter 5), but recent dating of plants of African origin (including sorghum and finger millet) in South Asian sites is suggesting that their domestication in Africa must be of greater antiquity than hitherto supposed (Fuller, 2003b).

LATE PLEISTOCENE FORAGERS

Though anatomically modern humans are older than 150,000 years in Africa, the antiquity of modern cognitive behaviour is much debated, the evidence for the use of ochre and shells for ornament, along with bone-working and the practice of fishing, generally dating from about 50,000 and later. However, carbonized lenses at Klasies River Mouth thought to date to about 90,000 years ago resemble the humified burnt residues of geophytes on nearby Holocene sites, and their sustained use may have required controlled burning of the landscape (Deacon, 1989). If so, it would be the earliest example yet known of Pleistocene foragers deliberately burning parts of their landscape to enhance food supplies.

It used to be thought that the equivalent of the Pleistocene glaciations of northern latitudes were 'pluvials', wetter episodes, but it is now clear that the predominant characteristic of Pleistocene climates in Africa was aridity. In North Africa, the Last Glacial Maximum was cold and hyper-arid. Average temperatures were lower than today by nine degrees centigrade, snowlines in the mountains of Ethiopia and East Africa were 1,000 metres lower than today (Messerli *et al.*, 1980), lakes dried up (the floor of Lake Victoria was dry, for example), and Saharan dunefields extended some 500 kilometres further south than their present boundary (Grove, 1980, 1993; Maley, 1977, 2000; Petit-Maire and Riser, 1981; Petit-Maire *et al.*, 1983; Talbot, 1980; Williams and Faure, 1980). In northern Mali, rainfall was only 20 per cent of the modern—very low—values there (Petit-Maire, 1991). As large parts of the interior of North Africa became uninhabitable, foragers retreated to the better-watered regions bordering the Sahara, the Mediterranean and Atlantic coasts, and the Nile valley.

Most coastal settlement of the period has been lost by subsequent sea level rise, but one coastal location that has yielded evidence of continuous settlement at this time is the Haua Fteah, an enormous cave on the northern side of the Gebel Akhdar ('Green Mountain') in Cyrenaica, north-east Libya (McBurney, 1967). The occupants used projectile points to hunt animals like hartebeest, aurochs, gazelle, and, in particular, Barbary sheep. Barbary sheep is also the main animal represented in the faunal samples at a number of contemporary sites in the Maghreb (Lubell, 1984). Saxon *et al.* (1974) argued

from sex and age ratios that people may have started to herd Barbary sheep at this time, but a detailed re-analysis of the Haua Fteah faunal material suggested that this is unlikely (Klein and Scott, 1986). Most of the sheep killed were young adult animals, but younger and older animals were also well represented in the faunal sample (Fig. 8.5). This 'catastrophic' kill pattern is thought to result from communal hunting methods such as driving animals over cliffs, rather than individual hunters stalking selected animals, or herders

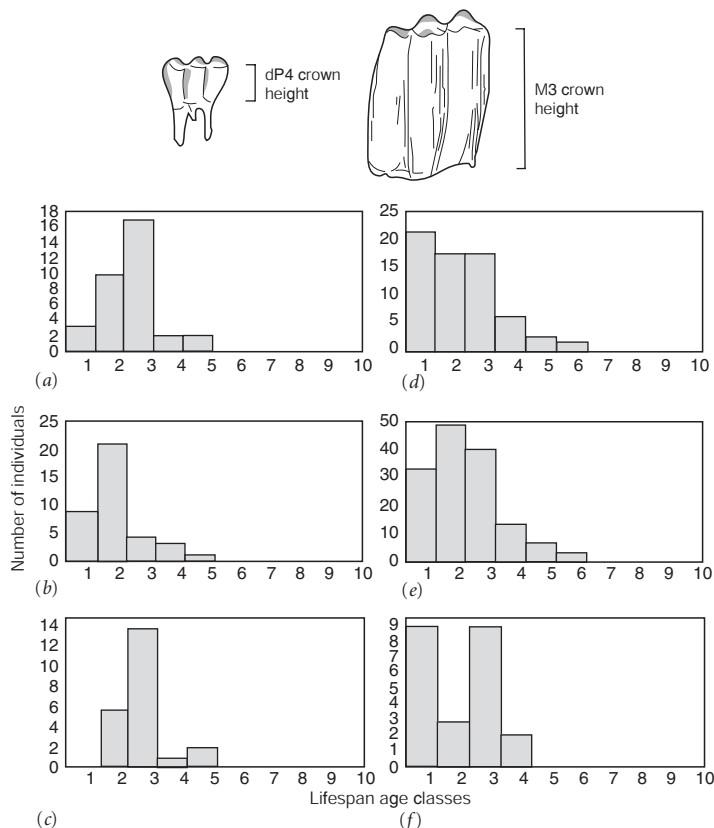


Fig. 8.5. Mortality profiles for Barbary sheep killed at Haua Fteah and other sites in Cyrenaica; at the top are shown the crown height dimensions of a deciduous (dP4) and a permanent (M3) molar, used to estimate age at death, the basis for the mortality profiles below: (a) Barbary sheep, late Palaeolithic Dabba; (b) Barbary sheep, late Palaeolithic Haua Fteah; (c) Barbary sheep, Mesolithic Haua Fteah; (d) Barbary sheep, Neolithic Haua Fteah; (e) all sheep and goats, Haua Fteah; (f) presumed domestic goats, Neolithic Haua Fteah; each age class represents 10 per cent of the potential lifespan, from youngest (1) to oldest (10) (after Klein and Scott, 1986: fig. 9)

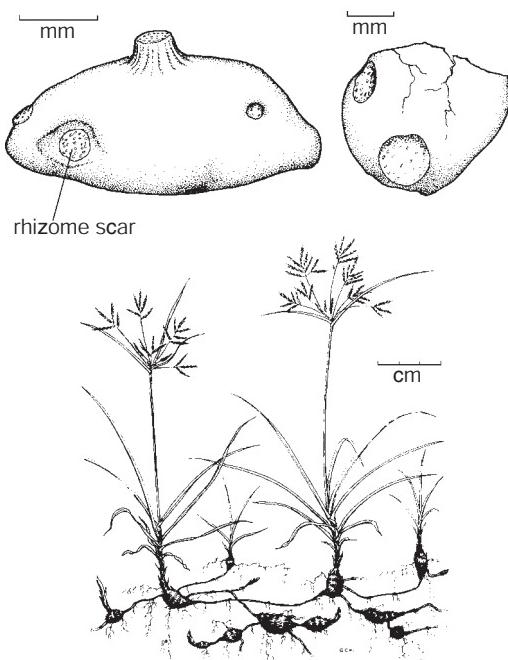
selecting animals from a controlled flock. Similar kill patterns were found of the Barbary sheep that formed the main prey at another Gebel Akhdar cave, Hagfet ed-Dabba. The Maghreb sites of north-west Africa have also produced grinding stones and blades with 'sickle gloss'. It has been suggested that the area might well have been a refugium for wild wheat and barley in the late Pleistocene (Williams, 1984; H. Wright, 1976), but unfortunately botanical remains have not been found to show what plants people were gathering (Lubell, 1984).

The Nile 18,000 years ago was a small sluggish river some fifteen metres higher than its present level, seasonally flooding a narrow band of marshes and meadows on either side. Most late Pleistocene sites here are very small, but there are indications that many locations were repeatedly occupied, presumably on a seasonal basis (Hassan, 1980). People fished the river and hunted in the surrounding dunefields (Vermeersch *et al.*, 1989), but a major activity was collecting plant foods from the marshes and meadows. Upper hand-stones and lower shallow milling stones are common at all sites, and flint blades with lustrous edges were presumably sickles of some kind (Wendorf and Schild, 1976).

The most informative site regarding the nature of plant gathering at this time is Wadi Kubbaniya (Wendorf *et al.*, 1989). The site caused a great stir in the 1970s when domesticated barley, chickpeas, and lentils were reported from levels dated to c.18,000 years ago (Wendorf *et al.*, 1976, 1979), but they were uncharred, and subsequent AMS dating of some of the domesticated seeds made it clear that they were intrusive. However, detailed analysis by Hillman (1989; *et al.*, 1989b) of charred remains certainly of late Pleistocene date has identified seeds, fruits, and vegetable tissues of at least 25 plants, over half of which have been identified. All are edible plants that grow wild today in the Nile valley. The most abundant remains are parenchymatous tissues of tubers of wild nut-grass (*Cyperus rotundus*), a type of sedge (Fig. 8.6). Other plants included club-rush (*Scirpus* sp.), fern rhizomes, fruits of the dom palm (*Hyphaene thebica*), caper, water lily, and camomiles. Nut-grass would have been a good staple food, though they had to be parched and ground up, and the flour then washed repeatedly to remove toxins. Harvesting the nut-grass regularly would have automatically increased its yields, because removing old woody tubers stimulates the production of young palatable tubers. If people had disturbed the ground around nut-grass and removed competing plants, it would have been even more productive (Hillman, 1989). The starch found on the grinders from the site suggests that tubers were indeed more important than seeds in the vegetable diet.

The consumption of riverside plants, however, was part of a broad-spectrum diet. There were over 100,000 fishbones at the site, for example,

Fig. 8.6. Wadi Kubbaniya, Egypt: (above) charred remains of stem tubers of wild nut-grass (*Cyperus rotundus*) gathered by Nile valley foragers c.15,000 BC, and (below) the modern plant (after Hillman *et al.*, 1989b: fig. 7.6, kindly provided by Gordon Hillman)



mainly of catfish (van Neer, 1989). Birds were predominantly waterfowl such as ducks, coots, and geese, probably caught variously by spears, nets, and traps. Molluscs such as *Unio* were collected. Game hunted included hare, ass, aurochs, gazelle, large antelopes, and even hippopotamus (Gautier *et al.*, 1980; Wendorf *et al.*, 1988, 1989). The wealth and diversity of the food remains suggest that all-year-round occupation would have been possible at Wadi Kubbaniya, even if food was not stored (Hillman, 1989: 231), but the small size of most of the Nile valley sites implies that people shifted between locations at different seasons (though probably not very far).

Sites with similar artefact assemblages and faunas of game, waterfowl, and fish, though without the abundance of plant remains of Wadi Kubbaniya, have been found from the Nile delta to the upper Nile and its tributaries such as the Atbara (Marks, 1989; Marks *et al.*, 1987; Peters, 1990; Wendorf and Hassan, 1980; Wendorf and Schild, 1984). Pollen studies indicate that barley was growing in the lower Nile, and it is possible that, in the Delta region at least, barley was one of the grasses exploited by these foragers (Williams, 1984). Further south we must assume that Nile marsh plants of the kind collected at Wadi Kubbaniya were staple foods.

By the closing millennia of the Pleistocene, as rainfall increased, the Nile changed to a swift-flowing deep river, and people living on its banks concentrated more and more on fishing and marsh-plant gathering. At Tushka

in southern Egypt, for example, there was an encampment with hundreds of hearths. Catfish dominated the faunal sample, and the skeletal parts (heads and upper vertebrae only) indicate specialized processing. Many fish were probably smoked for later consumption. The importance of vegetable foods is suggested by the very large numbers of grinders (Wetterstrom, 1993). Makhadma has similar evidence (Vermeersch, 1998; *et al.*, 1989).

Whilst many of the Nile sites are probably seasonal occupations, the indications from Wadi Kubaniya are that the valley was also supporting increasingly sedentary forms of subsistence before the beginning of the Holocene. Furthermore, several coprolites from infants were found at Wadi Kubaniya, their contents indicating that infants were being weaned on a vegetable mush from plants like club-rush and camomile (Hillman, 1989). Whilst it is not clear whether this diet allowed more infants to survive, the overall increase in site numbers by the end of the Pleistocene certainly seems prima-facie evidence that the Nile population was experiencing significant growth at the end of the Pleistocene. One result of increasing population densities amongst a population restricted to the Nile valley, with desert on either side, may well have been increasing inter-group rivalry for resources. For example, most of the people in one of the main cemeteries of the period, at Jebel Sahaba, had died violent deaths, probably from arrow wounds (Wendorf, 1968). The fact that those killed included women and children as well as men suggests that we are not dealing with ritualized combat (between young males for example) but more endemic violence. The use of aurochs horn cores as grave markers indicates that cattle had some kind of special status for these Nile communities (Close and Wendorf, 1992: 67).

In Ethiopia, evidence for late Palaeolithic subsistence was found in the Laga Oda rock shelter. Many stone tools have sickle sheen, and microlithic flints with mastic adhering to them look as if they had been set as blades in sickles, suggesting the importance of gathering seed plants here too (J. D. Clark and Williams, 1978). Brandt (1984, 1986) postulated that these plants would presumably have included the wild ensete that must have been widespread in this region, and that it is quite likely that people had started to practise horticultural activities such as transplanting ensete, and storing it. However, whilst the theory is inherently plausible, unfortunately there is as yet no definite evidence. East Africa is known to have been hyper-arid until the terminal Pleistocene, at which point there is evidence for sparse forager populations equipped with microlithic industries (Ambrose, 1984; Kusimba 1999).

The landscape of tropical West Africa was more open than today at the LGM, with denser vegetation returning with higher rainfall at the end of the Pleistocene (Mercader, 2003). One of the main sites with evidence for human settlement at this time is the Shum Laka rock shelter in Cameroon. It was probably situated at the junction between montane and semi-deciduous

forest, because animals from both habitats are represented in its faunal sample (de Maret and Clist, 1985; de Maret, 1993, *et al.*, 1987). Nothing is known, however, of the role of plant gathering. On the basis of ethnographic observations of tropical foragers today, Harris (1976) postulated the likelihood of an 'ancient stratum of protocultivation' in tropical West Africa, involving the collection and casual replanting of yams and other tuberous plants. As we have seen in Chapters 6 and 7, there is now good archaeological evidence that horticultural activities of this kind were a feature of late Pleistocene foraging in the tropical forests of Asia and the Americas. However, no plant remains have yet been recovered from late Pleistocene sites in tropical Africa, nor pollen diagrams published with indicators for or against clearance activities (Casey, 1998; Eggert, 1992, 1993).

In South Africa, there is evidence that fishing was important as well as hunting and gathering, on the evidence of sites such as Sehonghong rock shelter in Lesotho (Mitchell, 1996) and Elands Bay Cave at the Cape (G. N. Bailey and Parkington, 1988; Parkington, 1980, 1990). Sehonghong, on the eponymous river (a tributary of the Orange), was occupied by foragers from about 30,000 years ago, with evidence for fishing beginning in the late Pleistocene layers. Elands Bay Cave was used for hunting a variety of small antelopes and collecting animals such as tortoise, and ostrich eggs. As rising sea levels at the end of the Pleistocene brought the coastline nearer to the cave, it was used increasingly for harvesting limpets. (Whether shellfish were also important earlier, collected at coastal sites now flooded, is not known.) The numbers of very young antelope indicate that hunting was a mainly individual activity, rather than communally based drives of the kind suggested for Barbary sheep hunting at the Haua Fteah at this time. Over time the use of the cave changed from a short-season hunting station to a camp used by whole families for a wide range of domestic activities. There is no direct evidence for the role of plant foods in the diet, but the lack of grinding equipment suggests that plant processing was not a critical activity. The general impression is that by the end of the Pleistocene there were small-scale populations of foragers in South Africa, clustered at riverside and coastal locations offering a relative abundance and diversity of food sources.

TRANSITIONS TO FARMING IN AND AROUND THE NILE VALLEY

The transition to the Holocene was characterized throughout North Africa by the development of wetter climates than today, as the southern monsoonal belts shifted northwards. Though sampling problems are undoubtedly

inherent in the data, it seems clear that, from south to north, there was a time lag of several thousand years in the onset of humidity (Grove, 1993; Williams, 1984). At the maximum, rainfall in the early Holocene has been estimated variously at 5–15 times modern levels, resulting in lakes that were up to 100 metres higher than today's levels (Grove, 1993). In the following millennia these more humid conditions were punctuated by a succession of drier oscillations, before the eventual development of today's arid climate by about 4000 years ago (Kröpelin, 1987; Neumann, 1987; Petit-Maire, 1991; Ritchie and Haynes, 1987; Ritchie *et al.*, 1985). There is considerable uncertainty about the exact timing of these oscillations, their scale, and the extent to which apparent variations in the regional chronologies of climatic change across the Sahara and the Nile valley are the result of sampling problems, or are real. One view is that the early and mid-Holocene climate oscillated backwards and forwards between humidity and aridity; another is that, as B. D. Shaw (1976: 137) put it, there was 'a step-like progression through successively drier humid phases via periods of climatic deterioration rather than ... any real oscillation between arid and dry phases'. In the Nile valley and the hinterland on either side, significantly higher rainfall than today is indicated by high lake levels from the beginning of the Holocene to the late seventh millennium bc. There then seems to have been a period of short sharp fluctuations over a few centuries before another period of humidity developed from the early sixth millennium bc to the mid-fourth millennium bc, after which time aridity was dominant (Butzer, 1980; Close, 1987; Wendorf and Hassan, 1980; Wendorf and Schild, 1980, 1984; Wetterstrom, 1993).

The climatic amelioration of the early Holocene greatly increased the force and unpredictability of the Nile's flooding cycle. People living along its banks had to be much more mobile to respond to the dangers of flooding. They continued to rely heavily on fishing, but developed more sophisticated techniques involving deep-water fishing in the main channel as well as shallow-water techniques. Species like catfish continued to be important, but many faunal samples have numerous bones of Nile perch, a deep-water species that can grow to over 100 kilograms in weight (Hassan, 1986b; Vermeersch, 1998; Wetterstrom, 1993). Strong bone harpoons were developed for this fishing, though nets were probably used as well. The large number of hearths at many camps suggests that much of the catch was smoked. Hunting was practised both within the Nile valley and also on what are today the desert margins that were then savannah scrub and grassland; the faunas include waterfowl, turtles, hare, gazelle, cattle, hartebeest, crocodile, and hippopotamus.

People were now able to expand westwards, settling in depressions where permanent lakes ('playas') formed. The lakes and marshes of the Fayum depression, for example, were ringed with small early Holocene camps, which

have produced the same evidence for fishing (though not of the big river species) and hunting as the contemporary sites by the Nile (Hassan, 1986a, 1986b; Wenke and Casini, 1989; Wenke *et al.*, 1988). In addition to using microliths to make projectile points, people mounted fish jaws as arrowheads. The Fayum sites have also produced huge numbers of grindstones, together with remains of plants such as sedges, *Polygonum*, and *Rumex*, the kind of floodplain plants that formed the basis of initial horticulture in eastern North America (Chapter 7, p. 242), and there is a strong possibility that they were being exploited in much the same way. There were strongly seasonal patterns of movement, focused on the playas but also involving camps on the surrounding plateau (Brewer, 1989b).

Another depression colonized at this time was Nabta Playa in southern Egypt. The earliest Holocene camps were small tent-like structures, some with stone-lined storage pits, whose occupants hunted hares, rabbits, and gazelle (Wendorf and Schild, 1984). By 6000 BC there are indications of rather more substantial settlements, and of pottery-making (Wendorf and Schild, 1980; Wendorf *et al.*, 1998). Site E-76-6, for example, consisted of a series of hut floors, cooking hearths, and bell-shaped storage pits, arranged in two orderly lines. The first excavations yielded amongst the plant remains just three cereals grains (of naked barley, and two- and six-row hulled barley), but since then some forty varieties of plants have been identified, including legumes, *Scirpus*, *Rumex*, millet (*Panicum*), *Setaria*, *Ziziphus* fruits and seeds, mustard, caper, unidentified tubers, and sorghum (Wasylkowa, 2001; Wasylkowa *et al.*, 1993). The sorghum seeds (Fig. 8.7), which have been AMS-dated to c.6000 BC and so are certainly contemporary with the settlement, are morphologically wild, but infra-red spectroscopy and gas chromatography

Fig. 8.7. Grains of wild sorghum (*Sorghum bicolor* [L.] Moench. Subsp. *arundinaceum* [Desv.]) from Nabta Playa: (left) grain from dorsal side, embryo visible, from Hut 77/5, magnification c.28 \times ; (right) grain from dorsal side, embryo indistinct, from Hut 1/90, magnification c.27 \times (photographs by A. Pacholski, kindly provided by Krystyna Wasylkowa)



showed that they were closer in their internal structure to modern domesticated *Sorghum bicolor*.

Given that all the other plants at Nabta Playa were wild, Wasylkowa *et al.* (1993: 164) concluded that 'the whole plant assemblage points to a food economy based on wild plants, as far as the vegetal component of the diet is concerned'. Wild sorghum grows in abundance today in the Sahel, and would have been as abundant in the Sahara in the early Holocene (Harlan, 1989a). It has a very thick stem, so cutting the head off requires a very robust sickle, leading Stemler (1980, 1984) to suggest that sorghum domestication in Africa was probably not feasible until metal tools were available. However, the occurrence of fully domesticated sorghum in South Asia by c.2000 BC implies that its domestication processes extend back considerably further in time in Africa (Fuller, 2003b). Sorghum can in fact be harvested efficiently by simply beating or shaking the seeds off the head into a basket (Harlan, 1993), and harvesting the crop in this way would not have promoted the morphological changes that come with seed selection and planting. Also, modern wild and domestic sorghums are fully inter-fertile and cross-pollinate very easily. People at Nabta Playa could have hand-harvested sorghum as a staple crop for a very considerable period before any morphological changes would have taken place (Wasylkowa, 2001; Wasylkowa and Dahlberg, 1999).

A playa-edge settlement like that of Nabta Playa has been excavated in the Farafra oasis, dating to about 4000 BC, with similar houses, cooking places, hearths, and the same range of plants (Barich, 1996; Barich and Hassan, 1984–7; Wetterstrom, 1998).

Like the botanical remains, the early Holocene faunal samples from the eastern desert of Egypt have been much discussed regarding the possibility of herding, in this case of cattle (Clutton-Brock, 1989b; A. B. Smith, 1986; Wendorf *et al.*, 1984). Gautier (1984) proposed that morphologically domestic cattle were probably present here from very early in the Holocene, and the (very limited) mortality data were taken to indicate that cattle were bred, like the herds of modern African cattle-keepers, for milk and blood rather than for meat (Wendorf and Schild, 1984). The domestication thesis was based on extremely fragmentary remains, and Gautier later retracted the idea (Gautier, 1987), but Close and Wendorf (1992) have proposed it on other grounds. The cattle bones at the early Holocene desert sites are of large animals, which would generally be taken to suggest that they were of wild cattle (aurochs, *Bos primigenius*). Cattle would not have been well suited to the landscape around Nabta Playa if, as the fauna imply, water was not particularly abundant. (The common animals are hare and gazelle, which need little water, whilst hartebeest, which has roughly the same water needs as cattle, is noticeably absent.) Hence the presence of cattle could imply that they were only there because

people had brought them, from the Nile, as domestic herds. Large wells dug by the Nabta Playa community indicate that they needed to ensure an adequate water supply, so perhaps for domestic animals as well as for their own needs. The rarity of cattle bones, Close and Wendorf argued, was because cattle were valued more alive than dead. It has to be said that an argument for cattle domestication based primarily on how few cattle bones there are gets rather tenuous at this point! The Nabta Playa community clearly fished, hunted, and gathered plants intensively (Harlan, 1989a), but whether or not they practised what we would recognize as horticulture and herding remains uncertain. Nevertheless, the evidence of repeated episodes of subsistence intensification described above, with their roots in late Pleistocene foraging systems, is clearly at variance with the traditional model of agriculture being introduced to the Nile valley by Proto-Asiatic-speaking PPNB farmers from the Levant.

The first indisputable evidence for domestic plants and animals in the Nile valley is not until the early fifth millennium BC in northern Egypt and a thousand years later further south, in both cases as part of strategies that still relied heavily on fishing, hunting, and the gathering of wild plants (Hassan, 1984, 1985, 1988, 1998; Wendorf and Hassan, 1980; Wetterstrom, 1993). The settlement of Merimde, excavated in the 1920s and again in the 1970s and 1980s, was situated at the delta edge and measured almost 25 hectares. It produced a suite of domesticated plants including emmer, hulled six-row barley, lentil and pea, as well as weedy plants such as *Lolium* that were probably harvested systematically as additional plant foods, like the fragments of sedge rhizomes found (Eiwanger, 1984, 1988). The Merimde community kept domestic sheep, hunted marsh and river species such as hippopotamus, turtle, and crocodile, and fished. El Omari, another substantial settlement of some 100 semi-subterranean huts, produced the same range of crops, plus flax, and the same range of game and fish, but more domestic animals: sheep, goat, cattle, and pig (Brunton and Caton-Thompson, 1928).

By c.4000 BC cultivation and herding were combined with hunting, fishing, and gathering at Hemamieh (Hassan, 1988). Sites near Naqada of the early fourth millennium BC have unequivocal evidence for herding in the form of pens floored with compacted dung, and emmer wheat, six-row barley, and flax were grown. However, herding and cultivation were combined with fishing, hunting, and gathering a range of wild plants that included *Lolium*, mayweed (*Anthemis*), clover (*Trifolium*—presumably collected as animal fodder), nut-grass, *Chenopodium*, *Rumex*, and the fruits of *Ziziphus* and *Citrullus colocynthis* (Litynska, 1993; Wetterstrom, 1993). At Kom in the Fayum, although there were scores of basket-lined granary pits, the crops stored in them included not just emmer and barley but also *Polygonum*

and wild nut-grass, and though the community herded cattle, sheep, and goats, they also relied heavily on hunting and fishing (Caton-Thompson and Gardner, 1934). In short, 'domesticates offered merely another resource to be utilized in an overall generalized procurement strategy' (Brewer, 1989a: 171).

It seems quite clear from the material culture of the Egyptian Neolithic sites that we are dealing with internal subsistence changes from foraging to farming that had their roots in late Pleistocene foraging systems, not a migration of Neolithic farmers from South-West Asia. It is possible that wheat and barley were indigenous to the lower Nile valley, whilst cattle were certainly native to the region. Whether cereals were indigenous or acquired through exchange systems, Wetterstrom (1993, 1998) suggests that people may well have started to cultivate them to compensate for the unpredictability of the Nile flooding regime, applying the arguments developed by Minnis (1985, 1992) and Wills (1992) for initial farming in the American South-West (Chapter 7, p. 247), that 'domesticates were therefore a means to improve the foraging system by diversifying it rather than replacing it' (Wetterstrom, 1993: 166).

At this stage, after many millennia of foraging systems based on harvesting the abundant fish, plant, and animal life of the Nile, people developed a commitment to mixed farming relatively suddenly. The shift coincided with dramatic changes in the size of settlements. Maadi is typical of the new kind of agricultural village (Caneva *et al.*, 1989). There were numerous huts and storage facilities, cemetery areas, well-developed crafts including potting using the slow wheel, and a full suite of domesticated plants (einkorn, emmer, bread wheat, spelt, barley, pea, lentil) and animals (cattle, dog, donkey, goat, pig, sheep). The adoption of the herding lifestyle in particular had profound consequences in terms of social relations, visible for example in interments of cattle and other animals in human cemeteries pointing to new ideologies and *rites de passage* (Wengrow, 2001). It marked the beginning of the dramatic process of social change that led to the hierarchically based Pre-dynastic societies early in the fourth millennium BC that provided the social foundations of the unified Pharaonic state established by 3000 BC (Hassan, 1984).

Wild sorghum remained an important crop for the ancient Egyptians. Tutankhamun's tomb, for example, had so much wild sorghum in it that it may have been stored there as fodder for animals in the afterlife. One site where the appearance of domestic sorghum can be well observed is Qasr Ibrim in Upper Egypt, where plentiful desiccated plant remains were recovered. The sorghum from the first millennium BC at the site is morphologically wild, whereas that from the Christian era is morphologically domestic. Furthermore, DNA studies show that all four of the sorghum species found at the site (wild, *bicolor*, *durra*, and an intermediate form, *bicolor/durra*) have identical genetic signatures, suggesting, though not proving, a relatively late domestication

event (Rowley-Conwy, 1991*b*; *et al.*, 1997). It may be that the morphological changes associated with 'developed domestication' took place in areas such as Egypt as sorghum was established as a crop outside the original range of wild sorghum. Haaland (1995) postulated that sorghum travelled to India in a wild form, was domesticated there, and returned to North Africa as a domestic crop, but this seems unlikely given the nature of the sorghum remains now found widely in South Asia, which show no signs of non-domesticated forms or of domestication 'in progress' (Fuller, 2003*b*).

FROM FORAGING TO PASTORALISM IN THE SAHARA

In the Sahara, the first major episode of humidity lasted to about 6000 BC in the interior and perhaps for another thousand years on the border with the Sahel (Grove, 1993; Maley, 1977; Neumann, 1993; Petit-Maire and Riser, 1981; Petit-Maire *et al.*, 1983; Williams, 1984). Lake levels in the Tadrart Acacus mountains of south-west Libya were high until about 6000 BC and again after about 5500 BC (Cremaschi, 1998). Petit-Maire (1991) calculated that rainfall in the early Holocene humid phase in the Taoudenni basin of northern Mali was some 300–600 millimetres a year, compared with 5–50 millimetres today. In general, wetter phases seem to have diminished in length and dry phases increased in frequency with distance into the interior (Grove, 1993). Full aridity had developed in the Tadrart Acacus by c.3000 BC, and a thousand years later on the Sahel border, though there is some evidence for a final wetter episode in the mid second millennium BC (Grove, 1993).

The transformation of the Saharan environment caused by the early Holocene climatic amelioration allowed Sahelian flora and fauna to colonize the interior of North Africa, and foragers to follow. The process seems to have been both rapid and comprehensive (A. B. Smith, 1980*a*). The better-watered highland areas of the Sahara such as the Tadrart Acacus (Fig. 8.8) were swiftly populated by foraging groups who also ranged out onto the scrub and seasonal grassland of the intervening plains (R. Kuper, 1993; Muzzolini, 1993; Roset, 1987; Smith, 1980*a*, 1984). The material culture of the mountain sites includes microlithic flint industries, bone harpoons (found in hundreds at some sites), and grindstones. These were associated with evidence for fishing, shellfish collection, and for hunting riverine animals like crocodiles, hippopotamus, and turtles, as well as savannah animals such as large and small antelopes and cattle. Plant foods collected included fruits, bulbs, nuts, and grasses in the Maghreb (Roubet, 1978), and in the Sahara grasses including wild sorghum and millet (Muzzolini, 1993; Smith, 1984). Pottery was also used from an early date, leading to debates years ago about whether these people should

be classified as 'Mesolithic' or 'Neolithic', or as Sutton (1977) proposed for the Sahara and the Sahel at this time, 'Aqualithic'. Recent evidence, however, is producing major shifts in our understanding of the sophistication of the methods by which these early colonists of the Sahara were exploiting animals and plants.

Some of the most remarkable evidence has been retrieved from interdisciplinary programmes of surveys and excavations by Italian teams in the spectacular Tadrart Acacus mountains of south-west Libya (Barich, 1984, 1987a, 1987b, 1998; Cremaschi and de Lernia, 1998a). In the early Holocene, caves in the Tadrart Acacus such as Uan Afuda (Fig. 8.9) and Thora were used as base camps by bands of foragers equipped with microlithic flint tools, who ranged out across the adjacent lowlands (now sand seas) to fish, kill waterfowl and other birds living near the lakes and pools, and hunt a range of small and medium-sized game, but especially Barbary sheep (Table 8.1). By the seventh millennium BC, coinciding with the first drier oscillation, there are indications of more sedentary behaviour at Uan Afuda, with the construction of wind-breaks and pen-like structures inside the cave. Furthermore, within the pen at Uan Afuda was a thick layer of ash, dung, and straw. Micromorphological analysis showed that the dung derives from ovicaprids (de Lernia, 1998a), and the only ovicaprid bones in the faunal sample at this time are Barbary sheep (Corridi, 1998). Furthermore, the cave has an awkwardly low ceiling, so it is difficult to explain away the dung as naturally occurring from wild sheep seeking shelter there, which in any case seems very unlikely given the association between the dung and the plentiful evidence of human occupation debris. The startling implication, as de Lernia (1998a, 1998b) points out, is that these Saharan foragers were experimenting with the herding of wild Barbary sheep at least 500 years before the appearance of domestic cattle and sheep in the locality.

The material remains left in the cave at this time included simple pottery decorated with impressed wavy lines, wooden tools (a suspension hook and a spatula), tools made of Barbary sheep horn, stone grinders, and fragments of baskets and cords, some of them with seeds of *Urochlea/Brachiaria* still attached to them (Fig. 8.10). The same seeds were found in herbivore as well as human coprolites, further evidence for the stall-feeding of Barbary sheep (Castelletti *et al.*, 1998). Other plant remains at the cave included wild millet (*Panicum/Setaria*), *Ficus*, *Boraginaceae*, and achenes of *Compositae* grasses. There was also a cache of stored Gramineae seeds at Fozzigiaren cave dated to c.6000 BC.

Cremaschi and de Lernia (1998b) concluded that, as aridity shrank water sources and diminished the amount of fish and marsh plant foods available, the foragers of the Tadrart Acacus not only intensified their use of seed



Fig. 8.8. The Tadrart Acacus mountains in south-west Libya (photograph: Graeme Barker)



Fig. 8.9. The Uan Afuda cave in the Tadrart Acacus mountains (photograph: Graeme Barker)

Table 8.1. Faunal remains from early Holocene rock shelters in the Tadrart Acacus mountains, south-west Libya

	Fish	Bird	Hare	Carnivore	Dassie	Ass	Warthog	Gazelle	Hartebeest	Barbary sheep
Uan Afuda 2	—	—	—	20.0	—	—	—	—	—	80.0
Uan Afuda 3	—	—	—	—	—	—	—	—	—	100.0
Thora East 1	—	1.9	3.8	1.9	3.9	1.9	—	9.7	—	76.4
Thora East 2	—	3.2	5.6	3.2	2.4	1.6	—	10.4	—	73.3
Thora East 3	7.0	6.6	20.3	8.3	1.0	1.0	0.4	8.9	—	46.3
Thora East 4	0.7	21.4	7.1	16.6	—	2.3	—	—	2.3	47.6
Uan Afuda 1	1.0	21.4	2.4	16.7	—	2.3	—	—	2.3	47.6
Uan Muhuggiag	—	—	13.2	—	—	—	—	20.0	—	66.6

Notes: The units are ordered in approximate chronological order, from Uan Afuda 2, c.8000 BC, to Uan Muhuggiag, c.5500 BC. ‘Hare’ also includes other rodents, and ‘gazelle’ includes both dorcas gazelle and dama gazelle.

Source: di Lernia, 1998b: 122.

Fig. 8.10. The Uan Afuda cave: fragments of baskets dating to c.7000 bc used for harvesting or storing wild seeds, some with seeds of *Uruchloa/Brachiaria* still attached (di Lernia, 1998a: fig. 22; photograph kindly provided by Salvino di Lernia)



plants but also started to manage Barbary sheep, stalling and feeding them when the natural food and water supplies for them were at their most meagre. The pollen in the dung at this and other caves indicates that it accumulated in the late winter and spring, the driest part of the year. It is interesting to note that, although Klein and Scott (1986) argued that the Barbary sheep killed at the Haua Fteah could be explained in terms of communal animal drives, the Mesolithic ('Libyco-Capsian') layers at the site have a more restricted killing pattern of Barbary sheep than either the late Palaeolithic ('Iberomaurusian') or Neolithic layers (Fig. 8.5). In the Neolithic layers we know that people were herding domestic sheep and goats and presumably not herding Barbary sheep, so given the peculiarity of the Mesolithic kills, it is conceivable that at this cave, too, there was the same kind of management of Barbary sheep in the early Holocene.

By the sixth millennium BC conditions in the Tadrart Acacus had slightly ameliorated, but the overall trend was to increasing aridity. A double rock-shelter termed Two Caves at Ti-n-Torha, in which simple stone structures were constructed like those in Uan Afuda, has produced much the same range of plant foods as at the broadly contemporary settlement of Nabta Playa, including wild millet and sorghum and other grasses such as *Echinochloa* and *Uruchloa/Brachiaria* (Barich, 1987a, 1987b; Wasylkowa, 1992, 1993). Pollen from the nearby cave of Uan Muhuggiag indicates a semi-arid landscape of shrubs and savannah at this time, and food remains collected in

the cave according to pollen and macrobotanical remains included millet, edible rhizomes, and buds of *Typha*, *Maerua crassifolia*, and *Aizoon canariense* (both plants collected by the Tuareg for their edible leaves), the edible fruits of *Phoenix*, and the edible fruits and seeds of *Balanites aegyptiaca* (Wasylkowa, 1992). The people using these caves were also eating fish, migratory birds, ungulates such as Barbary sheep, gazelle, and hartebeest, warthog, and smaller game such as hyrax and porcupine (Corridi, 1998). Their material culture included bifacially retouched arrowheads, grinders, and pottery.

There were fragmentary remains of cattle in the sixth-millennium BC levels at Ti-n-Torha, the wild/domestic status of which is unclear, but morphologically domestic cattle, sheep, and goats were certainly present at both Ti-n-Torha and Uan Muhuggiag in deposits dating to the fifth millennium BC (Gautier, 1987; Gautier and van Neer, 1982). Although domestic cattle have also been reported from a sixth-millennium BC context at Bardagué in the Tibesti mountains (Barich, 1998: 42), they do not seem to have been widespread in the Sahara until about 4000 BC or soon thereafter. By then there were domestic cattle not only in the Tadrart Acacus but also in the Grotte Capelletti in the Aures mountains of Algeria, Amekni and Meniet in southern Algeria, and Adrar Bous and Arlit in the Ténéré mountains of Niger (Gautier, 1987). At all of these sites pastoralism was fully embedded in pre-existing systems of foraging, systems that included intensive wild-seed harvesting as at Nabta Playa and, at Uan Afuda, incipient herd management. Hence it seems likely that we are dealing with a combination of local domestication by the indigenous populations of the Sahara together with the acquisition of novel resources from contacts with communities fringing the Sahara such as those of the Nile valley, rather than a Neolithic/Afro-Asiatic migration from the Nile valley (and ultimately South-West Asia) as has been traditionally argued. DNA studies of modern cattle in fact indicate that African taurine (unhumped) cattle are so different from cattle in Europe, South-West Asia, and South Asia that they must have diverged from them perhaps 20,000 years ago (D. Bradley and Loftus, 2000), and that they were then domesticated independently in Africa (Hanotte *et al.*, 2002; Loftus *et al.*, 1994).

Though some authors have preferred to link the beginnings of Saharan pastoralism with wetter oscillations after the first major humid phase (e.g. Clutton-Brock, 1989b), the broad contemporaneity between the appearance of fully domestic livestock and the overall trend to aridity is strongly suggestive that pastoralism began as a response to desiccation. In this interpretation, Saharan populations responded to the beginnings of desertification by reinforcing their existing foraging systems, intensifying plant gathering and trying new ways of managing key ungulates such as Barbary sheep and,

perhaps, cattle. The ensuing short-lived wetter oscillation may have allowed a relaxation in these strategies, but the inexorable shift to aridity from the late seventh millennium BC onwards promoted an increasing commitment to herding, of domestic cattle, sheep, and goats.

It is commonly assumed that the point of origin of early domestic livestock in the Sahara must have been the Nile valley, but the appearance of bones of morphologically domestic cattle in the two regions is approximately synchronous, and wild cattle were present in both in the early Holocene (A. B. Smith, 1980*b*, 1986). Hence it is perfectly possible that cattle were first domesticated in the Sahara and were then acquired by Nile populations, or that wild cattle were taken into domestication across the entire region as part of a single process (Chenal-Vélardé, 1998). The situation regarding domestic sheep and goats is even less clear. It is often uncertain from publications of very fragmentary faunal remains whether Barbary sheep, or domestic sheep and goats, or both, are represented at a particular site. Domestic sheep and goats have normally been assumed to be exotic to North Africa and introduced from South-West Asia (Clutton-Brock, 1993; Higgs, 1967), but they may have been a trade item amongst foragers in the central and western Mediterranean basin in the mid Holocene (Lewthwaite, 1986), so it is quite possible that they entered the Sahara from the Maghreb (the prehistory of which is poorly researched) instead of, or as well as, from the Nile.

One thing that is clear is that the whole of North Africa shared in similarities in material culture: over this vast area, styles of hunting and fishing equipment such as bone harpoons and fish-hooks were extremely similar, as were pottery forms (large round-bottomed vessels) and decoration (wavy-line motifs), even though fabric analysis shows that pottery was locally produced by individual communities (Hays and Hassan, 1974). So there were certainly effective systems of communication linking widely separated communities along which domestic plants and livestock could have been passed along with the social and symbolic behaviours associated with their use. The occurrence of Saharan materials such as ostrich egg shell and hippopotamus ivory in adjacent regions makes it clear that materials as well as ideas moved freely. It is salutary to remember, however, that after decades of theorizing based on the assumption that animal herding must have spread first from South-West Asia southwards to the Nile valley and then westwards across the Sahara, the Uan Afuda dung—the earliest unequivocal evidence for herding in North Africa, contemporary with PPNB villages in South-West Asia—belongs to the ‘wrong’ animal (the Barbary sheep) in the ‘wrong’ place (the central Sahara)!

The development of pastoralism seems to have been the context in which the interior basins of the Sahara were first used systematically, on a seasonal

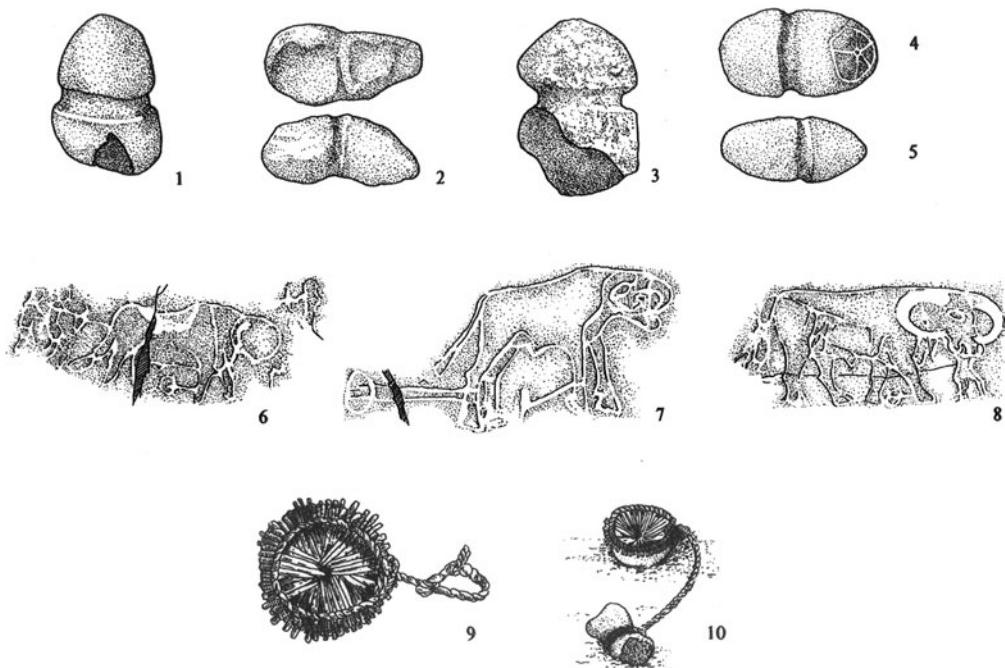


Fig. 8.11. Grooved stones found at pastoralist sites in the Sahara (1–5), rock art illustrations of their use as hobbles (6–8), a modern Tuareg trap using such a stone (9, 10) (after Barker, 1996: fig. 4.14)

basis (A. B. Smith, 1984). In many of these vast empty spaces there are enormous concentrations of what have been termed *Steinplatz* ('stone places'), small but dense collections of lithics, potsherds, and grindstones, sometimes with charcoal and bone fragments of domestic animals (Aumassip, 1987; Gabriel, 1987; Muzzolini, 1993). Some of these sites also have grooved stones which are thought to have been weights for rope traps or hobbles (Pachur, 1991; Le Quellec, 1990). There are pictures in Saharan rock art of both wild animals like giraffes and what are assumed to be domestic cattle with their legs haltered with such stones, and the Tuareg are known to have used weighted traps to catch game as well as to hobble stock (Fig. 8.11). The balance of probability is that Saharan pastoralists used such stones both for trapping game and hobbling livestock.

The most remarkable evidence left by these societies, though, is their rock art (Caligari, 1993). The wonderful images of animals such as crocodile and elephant were the first and most striking evidence for archaeologists that the Sahara had once been a verdant landscape far removed from its modern aridity. Most of the mountain massifs of the Sahara have rock walls,

often associated with settlement sites such as rock shelters, decorated with incised and painted images. There is great variability in technique and motif. The primary classifications of these by Lhote (1959) and Mori (1960, 1965) suggested that the art began with incised images of wild animals such as buffalo, elephant, giraffe (Fig. 8.12), ostrich, and crocodile being produced by early Holocene foragers, so termed by Mori the Big Game phase, or Bubaline phase after the buffalo images. Later pastoralists incised drawings and painted monochrome and polychrome images of people herding livestock, especially cattle but also sheep (the ‘Pastoral’ or ‘Bovidian’ phase: Fig. 3.12). Within this broad repertoire there were also images of campsites, hunting, gathering, and of round-headed people dancing and performing what look like other rituals (hence Mori defined a ‘Round Head’ style or phase). The lower image in Figure 8.12 shows cattle being milked and bags of milk products draining on racks.

The primary dating evidence for Saharan pastoralist art was the occurrence of fragments of painted rock that had fallen from painted images on the walls of the Uan Muhuggiag rock shelter into occupation deposits below dated by 14C to about 3000 bc. There were also images that were clearly later, such as horses pulling chariots and mounted warriors assumed to date to the period when the Egyptian pharaohs were conducting campaigns against the Libyans in the second millennium bc. Images of camels and palm trees indicating the present-day arid landscape of the Sahara were assumed to be later still. However, whilst the dating of the horse and camel motifs is reasonably secure, it has become increasingly clear from stylistic studies looking at details such as motif overprinting that there is no simple chronological separation between the images of wild (= ‘Mesolithic’) and domestic (= ‘Neolithic’) animals. Most images of both categories are probably broadly contemporaneous, forming a single if diverse corpus of image-making dating to the millennia of the mid-Holocene when people were changing from foraging to pastoralism (Le Quellec, 1987; Muzzolini, 1986, 1993, 2000).

Studies of San rock art have shown the complexity of the ideological contexts in which foragers make rock art (Lewis-Williams, 1983; Lewis-Williams and Dowson, 1990): the painted record is a coded message, not an open book (Parkington, 1989: 24). For the San, the making of an image such as a rock carving or painting is just a small part of complex rituals such as initiation or rain-making ceremonies, often produced by people such as shamans after they have experienced a state of trance. The development of a commitment to herding animals by prehistoric foragers such as those of the Sahara surely involved major transformations in the social relations of production and the ideology of prestige (Ingold, 1980). In most forager societies today, hunters get prestige by demonstrating prowess in the hunt and generosity in distributing

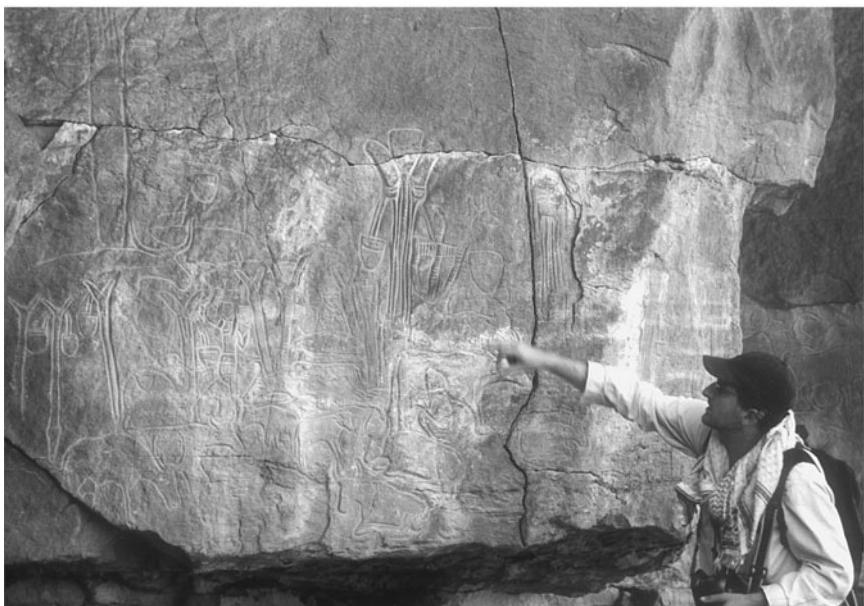


Fig. 8.12. Saharan rock art: (*above*) 'Big Game' engravings of giraffes in the Messak Settafet, south-west Libya; (*below*) a herd of cattle: the figure is pointing to one that is being milked, and there are also images of hanging baskets presumably containing milk or yoghurt (photographs: Graeme Barker)

their kills to the rest of the band, whereas prestige in modern pastoralist societies comes from accumulating live animals and using them in competitive arrangements of gift-giving for bridewealth and such like. Whilst one-to-one analogies are clearly inappropriate, there is every reason to believe that Saharan rock art, like recent San and Australian Aboriginal rock art, was embedded in complex belief systems. It was being produced as the old ways of living were becoming increasingly a 'landscape of memory', and as new ways were being developed for coping with an increasingly hostile environment, transformations that (bearing in mind the discussion in Chapter 3 of present-day foragers and farmers) meant both new ways of looking at the natural world and new social relationships. Saharan pastoral art may have been produced, like much San art, by shamans in altered states of consciousness, perhaps in relation to initiation ceremonies of the kind undergone by young male Fulani pastoralists in recent times (A. B. Smith, 1993*a*, 1993*b*). There are images of what seem to be rituals associated with baskets of seeds, others with tethered animals, males and females dancing together, people apparently levitating, and an image of a supernatural being spreading rain (Sansoni, 1998).

Saharan pastoralism was combined with the gathering of seeds such as millet and sorghum between the fourth and the second millennia BC, but the extent to which, if at all, these people also practised horticulture is entirely unknown. The first definite evidence for the latter dates to the beginning of the first millennium BC. In the Fezzan region of south-west Libya, in the el-Agial oasis north-east of the Tadrart Acacus, numerous and sedentary populations developed at this time whose cereal farming was sustained by irrigation using foggara technology (Mattingly 2000; *et al.*, 1998; van der Veen, 1992). The area was the home of the Garamantes tribe known to us from the classical authors, whose capital was Garama (modern Germa). It was the Garamantes whose cattle were famously described by Herodotus as 'oxen which, as they graze, walk backwards. This they do because their horns curve outwards in front of their heads, so that it is not possible for them when grazing to move forwards, since in that case their horns would become fixed to the ground.' The description has been much debated, in that the prehistoric cattle represented in faunal samples from Saharan Holocene sites have short horns, and both Saharan rock art and Egyptian tomb paintings show cattle with both short and longer horns (Fig. 8.12). Egyptian paintings also show cattle with and without humps. It used to be thought that zebu (humped) cattle were imported into Africa from India in Islamic times (Clutton-Brock, 1989*b*), but DNA studies suggest that they were first domesticated in South Asia and subsequently introduced into East Africa, perhaps in the second millennium BC (Hanotte *et al.*, 2002).

FORAGING, FARMING, AND PASTORALISM IN THE SAHEL

In the valleys of the Blue and White Nile and the major tributaries of the upper Nile such as the Atbara, the early Holocene humid phase witnessed the development of very similar 'Aqualithic' societies to those further downstream. Pottery was manufactured as early as the eighth millennium BC on the evidence of Sarurab, on the site of modern Khartoum (Haaland, 1995; Haaland and Magid, 1995). By 6000 BC sites such as Aneibis, Abu Darbein, and El Damer at the confluence of the Nile and the Atbara consisted of substantial occupation deposits several thousands of metres in extent and over a metre thick (Haaland, 1995). These and other sites in this region have produced large numbers of bone harpoons and spears and perforated potsherds that are probably net weights, and over 30 species of fish. The latter consist of both shallow-water species from the annually flooded marshes such as *Tilapia*, *Clarias*, and *Barbus*, and open-water species such as *Bagrus*, *Synodontis*, and *Lates*, the perch (*Bagrus*) bones belonging to specimens that must have been over two metres in length (Peters, 1991, 1993). Big game such as elephants and giraffes were hunted, but the game most frequently caught were buffaloes and a range of antelopes such as kudu, roan, waterbuck, and dikdik from the river valley woods and marshes. Turtles, freshwater molluscs, and landsnails were also important foods (Marks *et al.*, 1987). Plants gathered included *Celtis*, *Ziziphus* fruits, and *Setaria* seeds (Magid, 1989). The pottery used for storage and cooking at the contemporary sites of Saggai and Kabbashi al-Haitah in central Sudan has imprints of sorghum, millet, *Echniocloa colona*, *Setaria*, and *Ziziphus*. The fact that these were incorporated accidentally (the clay was tempered with sand, not vegetable matter) is an indication of the quantities of wild plant foods lying around these settlements (Magid and Caneva, 1998). As in the lower Nile valley at this time, people were probably semi-sedentary, moving only short distances up and downriver, though an elephant butchery site near Hassa Hesa between the Blue and White Niles indicates that hunting parties roamed further afield (J. D. Clark, 1984*b*).

The 'type site' of these forager societies is Khartoum itself (Adamson *et al.*, 1974; Arkell, 1949). There was a settlement of simple mud-plastered huts, used c.6000 BC by people who fished for catfish, lungfish, and Nile perch with barbed bone points and nets weighted with grooved stones and perforated stone rings; hunted game in the river marshes and the surrounding gallery forests (turtle, reed rat, python, crocodile, kob, buffalo, hippopotamus, elephant, rhinoceros, and a variety of antelopes); and processed plant foods in quantities, on the evidence of very large numbers of grindstones. Storage pits were also used. Plant remains were not recovered, but the assumption is that the main wild plant staples would have been sorghum, millets, and

teff. Shabona, 80 kilometres south of Khartoum, was a similar settlement (J. D. Clark, 1984*b*, 1989).

By c.4000 BC these systems of broad-based foraging were augmented by herding and possibly some kind of plant tending. The settlement that has given its name to the period in Sudan is Esh Shaheinab, 50 kilometres north of Khartoum (Arkell, 1953). The site measured some 6,000 m². It produced artefacts including wavy-line pottery, bone harpoons (including examples pierced for lines), shell fish-hooks, heavy axes and adzes, grinding stones, and the same kind of food refuse as at the earlier Khartoum sites, together with a few bones of domestic sheep and goats. At Kadero to the north of Khartoum there was the same range of marsh, woodland, and savannah birds and animals as at sites like Aneibis, and shellfish, but the main animals in the faunal sample were domestic cattle, sheep, and goats (Kryzaniak, 1978, 1991). There were huge quantities of worn-out or broken grindstones. The most plentiful plants recovered were hackberry seeds and the dom palm (*Hyphaena thebaica*), but there were also seeds of *Sorghum verticilliflorum* (both morphologically wild specimens, and others that might represent a primitive domesticated form), wild *Sorghum bicolor*, *Setaria*, *Citrullus*, *Celtis*, and *Nymphaea*.

The settlement was also accompanied by burials. Males were buried with stone mace-heads, pottery painted with ochre, and carnelian beads. There were also burials of women and children, and some of these were also well furnished with grave-goods. The disparities in the graves are very striking: most people were buried with nothing, but at the other end of the scale a few people were buried each with over a hundred pots and what look like highly valued items such as porphyry palettes and bracelets of elephant and hippopotamus ivory. Kryzaniak (1991) suggests that we may be seeing at Kadero the beginnings of hierarchically based pastoralist societies, for whom livestock had become the means to accumulate wealth and promote relations of dependency and clientship. Whilst it is wrong to transpose the Tuareg or Masai back to Kadero, the evidence for an important transformation in social relations coinciding with or soon after the beginnings of herding is very striking. However, we should also remember that these people were certainly not specialist pastoralists: they depended heavily on fishing, hunting and, perhaps increasingly, plant gathering—there were some 30,000 grinders at Um Direwa, for example (Magid, 1989). It is also thought that most of the activities that were critical to the maintenance of these societies (gathering plants, making storage bins, producing grinders, making pots, collecting water and firewood, and combining fire, water, pots, and plants into food) would probably have been undertaken by women (Haaland, 1995).

According to the Egyptian scribes of the third and second millennia BC, the peoples of Nubia (the upper Nile region) were a mixture of farmers, pastoralists, and foragers. The archaeological record presents the same picture

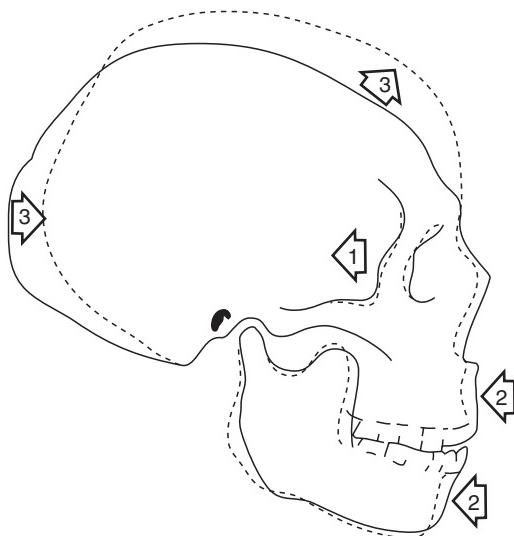


Fig. 8.13. Changes to the skull shape of prehistoric Nubians at the transition to farming: (1) reduction in size of muscles of mastication; (2) reduced growth of maxillomandibular complex; (3) reduction in cranial length and increase in cranial height (after Armelagos *et al.*, 1984: fig. 2)

in terms of the second and third groups, including the spectacular pastoralist societies of Kerma (see below), but it is still unclear when crop cultivation began on a systematic scale (J. D. Clark, 1984*b*). One interesting result of the eventual shift in diet from foraging to farming, though, was change to the physique of ancient Nubians (Fig. 8.13). The carbohydrate-rich diet of the Meroitic population of Nubia at the beginning of the Christian era, when sorghum and millet were the staple foods, promoted reduced muscles of mastication, smaller teeth, and less worn teeth compared with the people from sites such as Khartoum and Esh Shaheinab. These later Nubians also suffered more from nutritional deficiencies such as retardation of limb-bone growth, the development of premature osteoporosis (bone loss) in children and young adult females, and porotic hyperostosis, anaemia caused from iron deficiency (Armelagos *et al.*, 1984; D. L. Martin *et al.*, 1984). Today much of the sorghum harvest in this part of Africa is consumed as porridge or dumpling-like foodstuffs made of fermented dough, and fermented alcoholic beers. Beer in particular has a critical social role (in the male domain in particular), for hospitality, gift-giving, and for ceremonial occasions, for example for the feasts provided for male working parties after land clearance operations (D. Edwards, 1996). As in the case of maize in the Americas (Chapter 7), it is possible that the potential role of sorghum beer for such social relations may have been an important stimulus in its domestication.

At the climax of the early Holocene humid phase, the western and central Sahel consisted of virtually one enormous delta system from the mouth of the Senegal to Lake Chad (Ballouche and Neumann, 1995; Talbot, 1980). It is possible that one effect of these wetter conditions was to allow the tsetse

fly belt to move northwards into the Sahara, acting as a barrier to the spread southwards of pastoralism until more arid conditions returned to the Sahel (Krzyzaniak, 1980; T. Shaw, 1977; A. B. Smith, 1984). The present-day regime of wet and dry seasons may not have developed until the sixth millennium BC (Casey, 1998). In this wetland landscape of marshes, lakes, and rivers, fishing was the dominant subsistence activity, one remarkable example of the technologies developed for this being a dug-out canoe of mahogany over eight metres long found at Dufuna near Lake Chad in north-east Nigeria, dated to c.6000 BC (Breunig, 1996). Portères (1976) postulated that rice could have been taken into cultivation in this region at an early date, but though we can probably assume that it was one of the wild grasses collected by early Holocene foragers in the inland deltas, the first indisputable evidence for rice cultivation until recently was not until the first millennium AD at Jenne-jeno in the Middle Niger delta (McIntosh and McIntosh, 1983, 1984). More recently, rice from the nearby site of Dia (Bedaux *et al.*, 2001), AMS-dated to the first half of the first millennium BC, has been identified on size criteria as fully domesticated, implying that the process of domestication is indeed of greater antiquity (Murray, 2004).

One of the major studies of agricultural transitions in the western Sahel was by Munson (1976) in the Dhar Tichitt uplands in south-central Mauritania, on the present-day border zone with the Sahara in an area with an annual rainfall of only 100 millimetres. A series of sites was investigated along the shores of ancient lakes, dating mainly to the period 1500–500 BC. Some of them are extremely substantial collections of stone-built compounds and enclosures (Fig. 8.14). Fishing and hunting were critical activities at many sites, together with gathering. Mineralized seeds included hackberry (*Celtis integrifolia*), and seed impressions in potsherds were predominantly of kram-kram (*Cenchrus biflorus*), a grass collected today as a famine food. From the early deposits, however, there were also a few impressions of *Pennisetum* millet, identified as domesticated in form, together with bones of domestic cattle, and there were indications that domesticated millets were much more numerous thereafter. Munson concluded that people at Dhar Tichitt at first lived in rather ephemeral settlements as forager-pastoralists until about 1000 BC, and then responded to desiccation by settling down in large villages sustained by farming. Holl (1985) then argued that the ephemeral camps and village sites were more or less contemporary, the former being seasonal dry season camps in sandy interdunal depressions used for herding, fishing, and plant gathering, the latter being wet season settlements on plateaus where the millet husbandry was based.

The exact chronological relationships of the different kinds of sites remain unclear, but the occurrence of domesticates at c.2000 BC is also roughly when

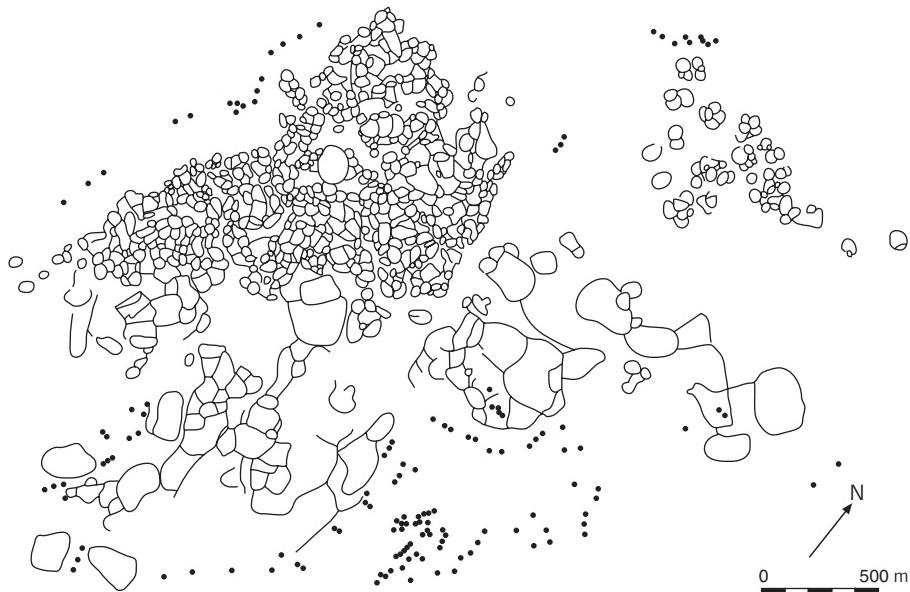


Fig. 8.14. Dakhlet el Atrous, at c. 80 hectares the largest of the Dhar Tichitt settlements: the enclosures are compounds and pens, not houses, and the dots indicate tumuli (after MacDonald, 1998: fig. 4.5)

they appear elsewhere in the Sahel (Amblard, 1996). This is the period when domestic cattle are reported not only from Dhar Tichitt but also Daima near Lake Chad and at Lake Turkana in northern Kenya (Gautier, 1987), as well as domesticated cereals at Dhar Tichitt and Karkarichinkat (Mali), and wild and domestic pearl millet, *Elaeis guineensis* (oil palm), and *Vigna unguiculata* (cow pea) at Kintampo in the savannah zone of Ghana (McIntosh and McIntosh, 1983). The community at Daima in its earliest phase lived mainly by fishing and collecting wild cereals, as well as herding (Connah, 1976, 1981). Pearl millet from Birimi in northern Ghana, firmly within the size range of modern domestic strains, has been AMS-dated to about 1500 BC (d'Andrea *et al.*, 2001), but the discovery of a large number of impressions of wild as well as cultivated pearl millet in pottery from Oued Chebi, a site about 100 kilometres south-east of the Dhar Tichitt settlements dating to c.1000 BC, is an indicator of the gradualness with which many Sahelians committed themselves as farmers (Amblard and Pernès, 1989).

MacDonald (1998) suggests that cattle rapidly became a critical means of signifying social relations in these societies. Stone rings and hachettes are found repeatedly in association with domestic cattle in the Sahara from the first appearance of the latter at sites such as Meniet and Adrar Bous. They are

often found far from the source of the material used, and they were frequently buried with the dead in tumuli. Hence he concludes that they spread from the Sahara into the Sahel along with the pastoral way of life, as a recognized medium of exchange amongst cattle-keepers. The propensity of pastoralism, cattle-keeping in particular, to facilitate relations of debt and obligation, and to sustain societies characterized by clientship, has already been mentioned. Dhar Tichitt, on this argument, was one of a series of semi-sedentary complex societies based on a pastoral ethic (if not on pastoral products in terms of diet) that developed in the Sahel, along with the Darfur region between Lake Chad and the Nile, and Kerma on the Nile. Kerma was a major power centre supplied by tribute from subservient communities. Excavations have revealed large numbers of 'royal tombs' of high-ranking people accompanied in death by large numbers of entire sheep and cattle skulls (Bonnet, 1990, 1992). In the desert conditions the sheep have been found perfectly preserved, complete with feathered head-dresses, fleece, and stomach contents (Chaix and Grant, 1993). Elsewhere in the Sahel, pastoralists lived alongside fishing and farming communities much as in recent decades in the Niger delta (Stenning, 1959). At Jenne-jeno, for example, a substantial settlement had developed by the early first millennium AD based largely on fishing and rice farming (McIntosh and McIntosh, 1980, 1984).

By about 2000 BC domestic cattle also seem to have been present in Ethiopia, at sites such as Godebra rock shelter (Phillipson, 1977b) and Lake Besaka. They are associated with sheep and goats, barley, and legumes in the first millennium BC at Lalibela Cave (Brandt, 1984, 1986). Complex models for the beginnings of farming in Ethiopia have been proposed on the basis of linguistics, most favouring colonization from different parts of North Africa, variously the Nile valley, the Sahara, and the Sahel. Brandt (1984), though, postulated that the beginnings of ensete and teff horticulture could well go back into the late Pleistocene. Unfortunately there is simply no archaeological evidence with which to assess any of these theories, nor the role of plant cultivation and stock-keeping both in respect to one another and to foraging. The appearance of rock art is assumed to relate to the social networks linking these early pastoral societies (Brandt and Carder, 1987).

THE GREAT UNKNOWN: TRANSITIONS TO FARMING IN THE AFRICAN RAINFOREST

The history of the tropical forests of West Africa is poorly understood. The landscape was certainly more open at the end of the Pleistocene than today, but the nature and course of Holocene vegetation change and the antiquity

of human settlement are unclear (Mercader, 2003). The tropical forests are the home of many wild forms of African staple crops, particularly the yams, and their domestication here is highly likely (Harlan, 1992, 1993; Marshall, 1998). Coursey (1976) argued that yams were probably not domesticated until knowledge of iron metallurgy spread to the region, because iron tools would have been needed to make clearings and till ground. By contrast, Harris (1976) suggested from the subsistence activities of tropical foragers today that, from very early in the history of settlement of the African tropical forests, foragers could well have been clearing vegetation to improve feed for game and growing conditions for plants such as yam, as we now know foragers equipped only with stone, bone, and wooden tools were able to do in the tropical forests of South-East Asia and the Americas (Chapters 6 and 7). Linguistic arguments have also been used by Blench (1996) to propose that domestication processes probably developed slowly, in different locations in the tropical region, with cultivation of crops such as yams going back as early as when Proto-Benue-Congo, the assumed proto-language of the present-day languages, was spoken. Given the difficulties of finding archaeological traces of such plants, however, compounded by the paucity of archaeological field research, very little is understood about when and how such plants were taken into cultivation.

An important stratigraphic sequence has been excavated in the Shum Laka rock-shelter in Cameroon. There were collections of quartz tools and the bones of tropical game in levels dated to c.5000 bc, but by about 2000 bc the tools became heavier and included polished axes and adzes (the latter could also have been used as hoes), there were sherds of pottery, substantial deposits of ash, and the remains of oil palm (*Elaeis guineensis*) and fruits of the incense tree *Canarium schweinfurthii* (de Maret, 1993, 1996; *et al.*, 1987). This was also the time at which pottery and ground stone axes and hoes started to become widespread along the west African coast (Anquandah, 1993; de Maret, 1986; T. Shaw, 1984), whilst in the interior, reconnaissance studies along the tributaries of the Zaire (Congo) river have shown that such artefacts are frequently associated with remains of oil palm and *Canarium* (Eggert, 1992, 1993, 1996). Shaw (1984) suggested that tropical foragers might have started to protect these plants by actions such as clearing competitor species from around them, whereas de Maret has argued for more systematic cultivation.

Oil palm can be eaten raw, or boiled or roasted, and is not a staple food in the region today because the principal crop is manioc. However, it is known that the latter was introduced from South America just a few centuries ago by Europeans. The morphology and physiology of the oil palm are such that the plant can propagate itself simply by dropping its endocarps, so without palynological studies it is difficult to know the extent to which its growth was

facilitated by Holocene foragers. Certainly the nuts and fruits of oleaginous trees such as palm oil, *Canarium*, and shea butter (*Butyrospermum parkii*) are often collected today from plants that are left entirely to fend for themselves (Posnansky, 1984). However, the consistent association of a plant such as the oil palm with stone axes and hoes and pottery (which would have greatly facilitated its preparation for consumption) is certainly suggestive, and points to a significant intensification in forest management (including horticulture?) at some time in the prehistoric past. Somewhat similar material to Shum Laka—pots, hoes, ash, mortars, and food plants (oil palm and *Coula edulis* nuts)—has been found at Okanda in the middle Ogooué valley in Gabon dating to c.1000 bc (Oslisly, 1996). It is often proposed that yam and oil palm cultivation are closely associated, and that the presence of the latter in archaeological deposits should imply the cultivation of the former (Stahl, 1993), but, again, whether or not yams were being cultivated by this time remains simply speculation.

Evidence for a mix of foraging and some kind of horticulture has been found at Kintampo and Ntereso in Ghana, on the northern margins of the tropical forests, dating to the middle of the second millennium bc (Flight, 1976). There was much evidence for fishing (bone harpoons and fish-hooks), hunting (stone arrowheads, and bones of a variety of antelopes), and for shell-gathering. There were also a few bones of domestic cattle and goats (Carter and Flight, 1972). Botanical remains included oil palm, *Canarium*, and cow pea, and there were also impressions of finger millet in the pottery. Though the morphological status of the latter is unclear, the assemblage as a whole is strongly suggestive that foraging was being supplemented by horticulture as well as herding. Furthermore, the pollen diagram from Lake Bosumtwi in Ghana registered a dramatic increase in oil palm during the second half of the second millennium bc, surely a pointer towards the active manipulation of tropical tree plants by this time (Talbot *et al.*, 1984). Charred seeds of *Pennisetum* have also been found as impressions in pottery from Obobogo in Cameroon dating to about this period, and though their morphological status is not known, their frequency indicates that finger millet was certainly being exploited on some scale by this time (de Maret, 1996).

The tropical archaeology of the first millennium bc is somewhat similar: for example, sites such as Batalimo in Burkino Faso, Sakuzi near Ngovo in the lower Zaire valley (Eggert, 1993), and Nkang in Cameroon (Mbida *et al.*, 2000) have produced evidence for a mix of hunting, fishing, and gathering being combined with small-scale horticulture. Remarkably, also, a sherd at Nkang was found to contain a phytolith of banana, *Musa* sp. (Fig. 8.15), a plant native to South and South-East Asia but not to Africa. Presumably it was introduced to Africa in a domesticated form, its occurrence at Nkang considerably later

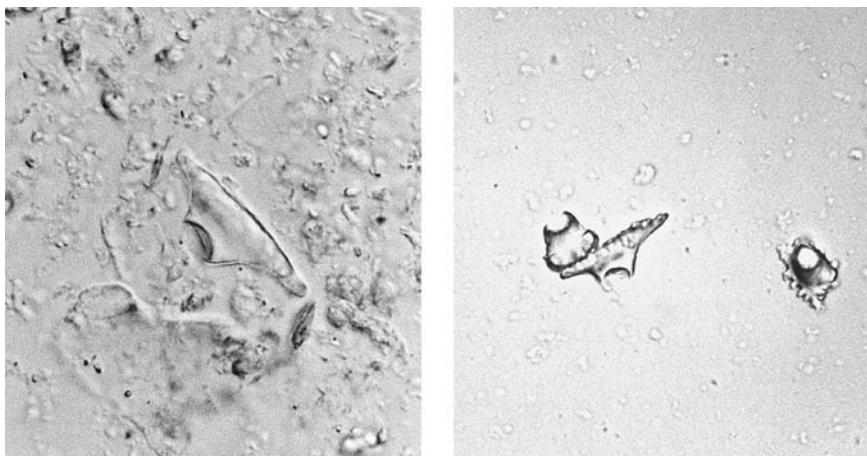


Fig. 8.15. A phytolith of a banana (*Musa* sp.) in a first-millennium BC potsherd from Nkang, Cameroon (left) compared with (right) a modern specimen; each phytolith measures approximately 20 µ in length (after Mbida *et al.*, 2000; photographs kindly provided by H. Doutrelepont)

than its initial arrival, we must assume, on the East African littoral. Nkang is also notable for the presence of a few bones of sheep or goat, the first domestic animals reported from the forest region proper. As significantly, Nkang like other contemporary sites in West Africa produced evidence for iron-working in the form of slag. Iron was worked in the eastern Mediterranean and Egypt from early in the first millennium BC, and at the end of the first millennium BC at Meroë in Nubia. Hence it has been assumed that knowledge of how to work iron must have spread from Nubia into sub-Saharan Africa during the first millennium AD. However, metallurgy now seems to have developed in the Sahel at an earlier date. Copper smelting was being practised at Akjoujt in Mauritania and Agadez in Niger in the first half of the first millennium BC, and there is increasing evidence that iron working was of similar antiquity in Niger, Gabon, Rwanda, and Burundi (Woodhouse, 1998). It is therefore quite possible that iron technologies were developed in the equatorial forests of West Africa as early as anywhere else in the world. The speed with which knowledge of metallurgy spread throughout West Africa can be understood in the context of the exchange systems that linked the forest populations, signified both by the extraordinary homogeneity of their pottery over enormous distances, and the exotic artefacts such as marine shells and greenstone axes found thousands of kilometres from where they must have originated (Stahl, 1993). Presumably the sheep or goats at Nkang were acquired in the same way through trade systems linking the region with the Sahel. The beginning of iron working in

West Africa coincides with a dramatic increase in the amount of pottery in the archaeological record, the two together often taken to be proxy indicators of the full establishment of tree and crop farming in the region. By the end of the first millennium BC, life for most forest-dwellers became increasingly sedentary as systems of arboriculture and horticulture, sometimes with herding on a very small scale (understandably so given the ecology of the region), were fully integrated with foraging (Stahl, 1993).

TRANSITIONS TO FARMING IN EAST, CENTRAL, AND SOUTH AFRICA

The early Holocene in East Africa was characterized by a relatively wet climatic regime. People using pottery and bone harpoons subsisted by combinations of hunting, fishing, and gathering, the preferred settlement locations being lake edges. The development of aridity after c.4000 BC coincides with the first evidence for the herding of cattle, sheep, and goats, which were widespread by the third and particularly the second millennium BC (Ambrose, 1984; Barthelme, 1984, 1985; Gifford-Gonzalez and Kimengich, 1984; Reid, 1996; Robertshaw, 1989; Robertshaw and Collett, 1983), though in this initial phase of pastoralism people continued to rely on hunting and gathering for their subsistence (Marshall and Hildebrand, 2002; Marshall and Stewart, 1994). Gravestones and stone pillars of possible astronomical significance at Namoratunga have what seem to be branding marks of the kind used by present-day herders, marks which commonly are also clan symbols (Lynch and Robbins, 1977, 1978). Other grassland sites have yielded faunas consisting almost entirely of savannah game, and there were fishing communities on the shores of lakes such as Lowasera on Lake Turkana (Phillipson, 1977c; Robbins, 1984).

One of the most detailed faunal analyses of the so-called Pastoral Neolithic of East Africa has been of the prolific material (over 165,000 fragments) from Prolonged Drift in Kenya (Gifford *et al.*, 1980; Gifford-Gonzalez, 1984). Domestic cattle were the predominant species, along with migratory herbivores such as zebra, wildebeest, komgoni, and Thomson's gazelle. The domestic dog was also present. The main cattle represented were older juveniles and adults, and this was the case also with regard to the major game species. So were cattle being treated in much the same way as game? Gifford-Gonzalez concluded that the faunal evidence from the site could support two quite different models (Fig. 8.16). In the first, highly mobile hunters followed migrating game, acquiring domestic stock from other communities as and when necessary; in the second, pastoralists practised restricted mobility, hunting

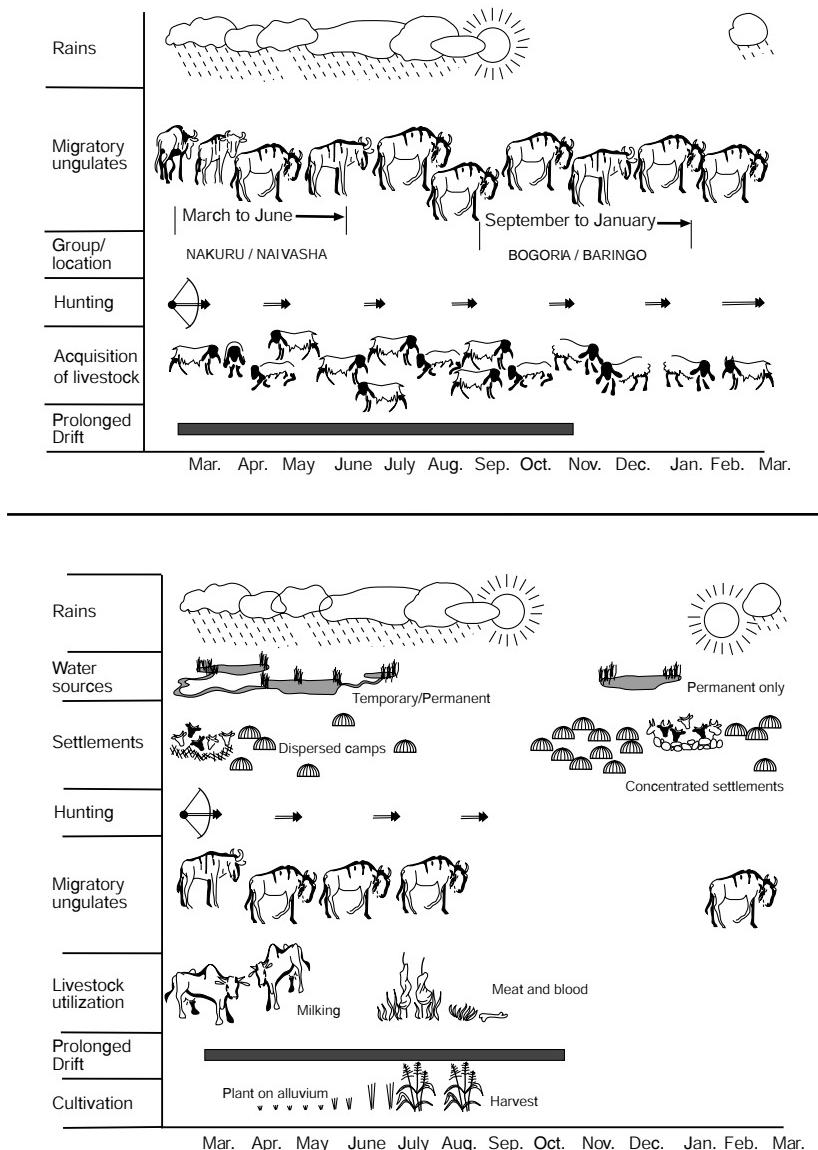


Fig. 8.16. Alternative models of how hunting and herding may have been combined at Prolonged Drift, Kenya, based on the analysis of the fauna: (above) highly mobile hunters following migrating game, acquiring domestic stock as necessary; (below) pastoralists practising restricted mobility, hunting as necessary and possibly also growing crops (after Gonzalez-Gifford, 1984: figs. 6 and 7)

as necessary and possibly also growing crops. She thought that the second model was probably more likely, though the excavations produced no evidence for crop cultivation. The important point, though, is that Prolonged Drift, like Gogo Falls (Robertshaw, 1993), was probably just one campsite used on a seasonal basis by a mobile 'mixed economy' group that would have left different kinds of farming, herding, and hunting residues at other camps they used elsewhere in different seasons. Such evidence makes the kind of linkages attempted by a number of scholars (e.g. Ambrose, 1982, 1984; Phillipson, 1984; Rightmire, 1984) between types of site (or more commonly, types of artefact assemblage) and different ethnic and/or linguistic groups, such as sites with Neolithic pottery representing incoming Ethiopian farmers and Sudanic herders, or sites with microlithic flint assemblages representing pre-existing foragers, highly problematical.

Most Early Iron Age (first millennium AD) settlements in South Africa consist of collections of plaster-floored huts, together with iron furnaces and ash middens. Whether herding began before mixed farming in South Africa, or vice versa, or whether they developed in tandem, is much debated. A critical problem is the paucity of organic remains, plant remains especially, from Early Iron Age sites (Mitchell, 2002; Sutton, 1996a). Thus surveys in Luano (Zambia) noted that many sites were located on the edge of seasonally moist basins ('dambos') well suited for growing cereals and root crops (Bisson, 1992), but though grinders are common, plant remains were rare (Wigboldus, 1996). On the other hand, evidence for cattle and sheep/goat herding, in combination with hunting, is widespread throughout Central and South Africa by the early first millennium AD (Voigt, 1986). Sites include: Matope Court in Malawi (Juwayeyi, 1993); Kadzi (Pwiti, 1996), Mabveni (Huffman, 1975), and Ntsitsana (Prins, 1996) in Zimbabwe; Mapungubwe (Voigt, 1983), Broederstroom (Mason, 1981), and the Lydenburg valley in the Transvaal (Marker and Evers, 1976); and Ndondondwane in the Tugela or Thukela valley in KwaZulu-Natal (Maggs, 1980, 1984; Voigt and von den Driesch, 1984). Livestock also included domestic dogs (Clutton-Brock, 1996) and chickens (Plug, 1993). Shellfish middens such as Enkwazini on the south-eastern coast have pottery and evidence for iron-working dating to the early first millennium AD, but lack animal and plant remains (Hall, 1981). Contemporary middens on the coast of Mozambique such as Matola also have bones of cattle, sheep, and goats (Sinclair *et al.*, 1993). Plant husbandry was practised where rainfall was in excess of 500 millimetres a year, the principal crops being pearl millet, finger millet, and sorghum, along with pulses and cucurbits (Table 8.2).

Domestic sheep had certainly arrived at the Cape region by the end of the first millennium BC, probably several centuries after the first use of pottery

Table 8.2. Domesticated plants reported from Early Iron Age sites in South Africa

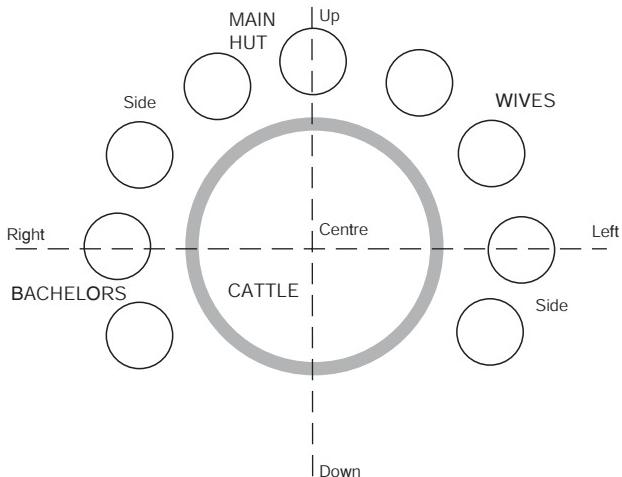
Site	Locality	Species
Kadzi	Northern Zimbabwe	Finger millet
Kgaswe	Eastern Botswana	Pearl millet, sorghum
Lanlory	Northern Zimbabwe	Cow peas
Leopard's Kopje	Matabeleland	Bambara groundnuts, cow peas, sorghum
Magogo	Thukela Basin	Cucurbits, finger millet, pearl millet, sorghum
Matlapeneng	Okavango Delta	Cow peas, cucurbits, pearl millet, sorghum
Maunatlala	Eastern Botswana	Cucurbits
Ndondondwane	Thukela Basin	Pearl millet
Nqoma	Tsodilo Hills	Cucurbits, pearl millet, sorghum
Schroda	Shashe-Limpopo basin	Sorghum
Shongweni	KwaZulu-Natal	Finger millet, pearl millet
Silver Leaves	Northern Province	Pearl millet

Source: Mitchell, 2002: table 10.1.

there, on the evidence of sheep bones (some AMS-dated) from sites such as Blombos Cave, Boomplaas, Die Kelders, Elands Bay Cave, and Nelson Bay Cave (Deacon *et al.*, 1978; Henshilwood, 1996; Klein, 1984; Schweitzer, 1974; Sealy and Yates, 1994). All these sites were predominantly used for hunting, so it has sometimes been argued that the sheep could just have been rustled by indigenous Khoi foragers from incoming Bantu farmers. However, the occurrence of sheep hair and manure at Boomplaas and Mirabib (Namibia), and the ages of the sheep, make it much more likely that people were combining sheep herding with game hunting (Klein, 1984), one theory being that these livestock were initially adopted as a source of prestige and status (Sadr, 2004). Laminations in the dung layers together with the age profiles of seals at Elands Bay suggest seasonal occupations (Plug, 1988). The occurrence of the sheep bones does not coincide with any change in the human skeletal record (Hausman, 1984).

One trend that does seem clear across East, Central, and South Africa is that cattle became consistently more frequent with respect to sheep and goats through the course of the first millennium AD. In part this may have been related to ecological factors, as forest clearance allowed cattle into areas that formerly were infested by tsetse (van Schalwyk, 1996; Schoenbrun, 1996). A pollen diagram in the Rukiga highlands of Uganda records accelerating levels of clearance in the later first millennium AD (Taylor and Marchant, 1996), and the increase of cattle over sheep at Ntsitsana at this time coincides with a decrease in charcoal of woody species (Prins, 1996). However, cattle-keeping also became increasingly important now in the context of changing social relations (Mace, 1993).

Fig. 8.17. Kuper's Central Cattle Pattern (after Mitchell, 2002: fig. 10.15)



Modern cattle-keeping societies in South Africa share characteristics in their organization that were defined by the anthropologist Kuper (1980, 1982) as the Southern Bantu or Central Cattle Pattern. These societies are generally patrilineal, the males accumulating cattle for bridewealth for wives, sacrifice to ancestors, and for cementing political relationships. The central role of cattle is reflected in the layout of the settlements (Fig. 8.17). There is a central area reserved for stalling cattle. The headman lives at the apex, opposite the entrance. Wives and junior relatives live lower down and further away on either side of the central enclosure, in rank order. Huts are divided into male and female sides by a central hearth. Grain is stored by wives near their houses, but by the headman in central pits or above-ground granaries in the central zone. The latter is associated with ancestor ceremonies, and women are commonly excluded from it. The settlement plan reflects highly formalized oppositions within society: male:female; public:domestic; top:bottom; and left:right.

The striking similarities between the organization of the present-day villages and the layout of many Early Iron Age settlements in South Africa have led archaeologists to suggest that Early Iron Age society was organized according to the Central Cattle Pattern (Huffman, 1993, 2001; Whitelaw, 1996). The settlement of KwaGandaganda in KwaZulu-Natal, for example, had a central area of cattle byres, forging sites, and ash middens surrounded by residential structures, granaries, middens, and working areas with grindstones, suggestive of an inner male and outer male/female area. The central areas of sites

such as this and Broederstroom have clay cattle figurines and incisors from young people, as well as pits containing deliberately broken pots, evidence suggestive of the initiation rites of modern cattle-keeping societies: tooth removal is a common feature of them, together with the ceremonial breaking of beer vessels to symbolize the defloration of young females (Whitelaw, 1996).

Lane (1996), however, has critiqued this kind of one-to-one structuralist analogy between modern and Early Iron Age societies, showing the likelihood of multiple meanings and contradictory symbolic principles in the material culture of the latter. Similar arguments have been made by Hall (1984), Maggs (1996), and Mitchell (2002). Nevertheless, the general thesis of the increasing importance of cattle in the social relations of many African agricultural societies is undoubted. By the first half of the second millennium AD, cattle-keeping was a critical part of the power of the elites who built the *zimbabwe* stone enclosures in Central Africa. The elites of sites such as Great Zimbabwe and Harleigh Farm (Zimbabwe), Mapungubwe (Transvaal), and Manekweni (Mozambique) controlled large cattle herds, from which prime animals were taken for consumption or exchange to maintain the relations of clientship that underpinned these societies (Barker, 1988; Huffman, 1971, 1981). On the Kalahari fringe in eastern Botswana, cattle pastoralism sustained other elite groups at centres such as Toutswe, a site that was the focus for hundreds of satellite herding sites in the surrounding bush marked today by thick silicified dung deposits (Denbow, 1982; Denbow and Wilmsen, 1983).

In the arid interior and western parts of South Africa, pottery and then pastoralism were gradually adopted by foragers during the course of the first millennium AD (Kinahan, 1991, 1993, 1996). The occurrence of dung (probably of sheep) and bones of domestic animals (mainly of sheep again) at sites in the !Khuseb delta in the Namib desert coincides with the use of larger pots, which may indicate the more intensive use of wild plants such as the !nara melon (*Acanthosicyos horridus*), and the need for better technologies to cook them, as well as for collecting and storing honey. The pottery, though, is much handled, and could have had ritual as well as practical significance. Many rock-shelters by waterholes have painted walls. The Snake Rock in the Hungorob Ravine (Fig. 8.18) has a sequence of motifs: monochrome male and female figures, perhaps participating in communal healing rituals, are overlaid by elaborate polychrome figures of males shown either singly or in small groups, as well as what are probably both wild and domestic animals. Building on the ideas of Lewis-Williams (1983), Kinahan concludes that ritualized shamanism may have developed amongst Namib hunter-gatherers, prior to their adoption of pastoralism, and that changing social norms and ritual practices must

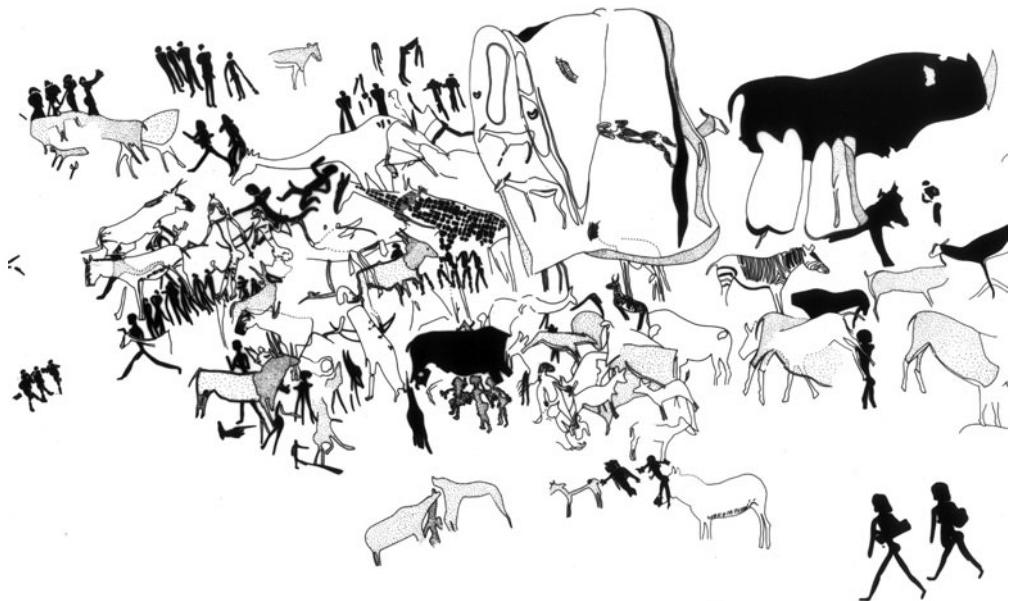


Fig. 8.18. Detail of the main frieze at Snake Rock, Hungorob Ravine, Namibia, its superimposed paintings possibly marking changes in social relations and ritual as hunter-gatherers became pastoralists (Kinahan, 1993: fig. 20.4; illustration kindly provided by John Kinahan)

have been one of the factors first in the adoption of pottery and then in the incorporation of pastoralism into existing systems of foraging.

CONCLUSION

For decades, the study of the beginnings of farming in the African continent has been dominated—and in many respects bedevilled—by attempts to recognize discrete cultural, linguistic, and ethnic entities in the archaeological record. Yet in trying to link languages, pots, people, and subsistence, archaeologists drawing arrows across the map of Africa frequently assumed—either implicitly or explicitly—the presence of new people despite the lack of skeletal evidence, and the presence of agriculture despite the lack of evidence at most sites for the subsistence activities of the inhabitants. As skeletal, faunal, and botanical data have become more plentiful, it is apparent that they do not support the simple models of colonization that have for so long underpinned most thinking about how Africans became farmers. As Lane

(2004: 246) comments, 'it has become increasingly apparent that the processes of demographic, linguistic, economic, and technological change were vastly more complex than initially presumed, and may well have operated independently of one another'.

The Klasies River Mouth evidence suggests that the practice of burning the landscape to enhance resources may be one of the earliest signatures of modern human behaviour. By the late Pleistocene, foraging may have sustained more or less sedentary communities in some favoured locations. It is quite likely that wild wheat and barley were being gathered by people living in the lower Nile valley, just as sorghum was at Wadi Kubbaniya. The dramatic development of wetter climates in the early Holocene allowed people to expand throughout the Sahara and the Sahel, sustained by broad-spectrum foraging. There is intriguing evidence for the precocious development in the Nile valley of 'floodplain weed horticulture' akin to that of central North America, and in the Sahara for the herding of Barbary sheep prior to the use of domestic sheep. DNA evidence suggests that taurine cattle were domesticated in Africa independently from South-West Asia, Europe, and India; at present both the Sahara and the Nile are equally likely candidates as the arena where this took place. The link between the appearance of morphologically domestic cattle, sheep, and goats at foragers' sites in the Sahara and the onset of desiccation there remains very striking. The origins of Saharan pastoralism may lie in people's attempts to maintain their diversified lifeways in the face of desiccation by exercising increasing control over selected prey animals.

If demic diffusion by Afro-Asiatic/PPNB farmers from South-West Asia was the primary process behind the transition from foraging to farming in the Nile valley (which clearly I do not believe given the evidence summarized above), it is very odd that farming in the latter played such a minor role at most Neolithic settlements compared with foraging. Mixed farming was only established in the fourth millennium BC, when it underpinned the pre-Dynastic chiefdoms that were the precursors of Pharaonic civilization. By the late third millennium BC, complex stratified societies had also developed in the upper Nile valley and the better-watered parts of the Sahel, for whom domestic animals, cattle especially, were a critical feature of elite power. Yet pastoralism continued to be combined with foraging in many parts of the Sahara and the Sahel, with the sorghums and millets probably hand-harvested in baskets in some regions for millennia before the use of metal sickles finally brought the morphological changes of domestication.

This complexity of the archaeological evidence for transitions to farming in North Africa can in fact be reconciled with the linguistic evidence. Whether linguists prefer South-West Asia or North Africa (or both) as the homeland of the Afro-Asiatic languages, in either case they date the proto-language

to the early Holocene or even the late Pleistocene, several millennia earlier than a putative PPNB migration c.6000 BC. Also, the theory that the earliest speakers were farmers depends on the assumption that terms identified in proto-Afro-Asiatic such as grains, grasses, and grinders must automatically refer to domesticates and their processing, rather than to wild plant collecting, whereas in the formative stages of the language group a correlation with wild grass collectors is just as likely (Blench, 1993; Ehret, 2002b). The origin of the Nilo-Saharan languages also may go back to the Saharan populations of the early Holocene, with the earliest usages of words for grain, grindstones, and grazing animals more likely to refer to foraging than to agriculture (Ehret, 1993). In both language groups, terminologies with indisputable agricultural connotations can only be identified in the more developed stages of the member languages.

For all the speculation about the possible antiquity of root and tuber manipulation in tropical West Africa, there is still no archaeological evidence for yams or other root crops. The timing and context of their domestication remain entirely uncertain. Oil-bearing nuts and fruits are increasingly common after 2000 BC, which is also when pottery (an important aid in the processing and cooking of plants such as yams) and stone axes (vital for clearing fields) first become widespread. It is possible that systematic horticulture is as early as arboriculture, but it is currently impossible to tell. Herding came much later, and then only on a very small scale.

The antiquity of crop farming throughout the rest of the sub-continent is also uncertain. The few sites with crop remains date to the first millennium AD, and mostly have indications of iron-working. It is possible that crop farming was only feasible on any scale when iron tools became available for clearing forest and tilling ground. However, given the absence of plant remains from earlier sites, we have no means of knowing whether or not late Pleistocene and early Holocene foragers in East, Central, and South Africa collected plants or practised more horticulture-type behaviours. The beginnings of pastoralism are slightly clearer, if not the reasons: domestic cattle and sheep were being herded in East Africa in the third millennium BC and were at the Cape by the late first millennium BC.

The manner of the appearance of domestic animals, pottery, crop farming, and iron tools in different parts of East, Central, and South Africa is no longer consistent with the predictions of the Bantu colonist model. They did not spread together, with coherent directional movements. Wherever good regional archaeologies have been established, the evidence invariably suggests that we are dealing primarily with existing populations adopting new resources, and integrating them into existing lifeways for subsistence and/or social reasons, rather than the arrival of Bantu colonist-farmers. Attempts

to try to reconcile the increasing complexity of the archaeological data with migration models in terms of complex linkages between archaeological and linguistic entities (e.g. Huffman and Herbert, 1996) can be criticized from the perspective of both disciplines (e.g. Ehret, 2001; Hall, 1987; Phillipson, 2002; Stahl, 1984; Sutton, 1996b). Within the Eastern Bantu, for example, precise mapping of the languages on the western side of Lake Victoria does not show any of the kind of spatial patterning in the occurrence of word stems associated with various staple crops that ought to exist according to the traditional model of proto-Bantu agricultural colonists (Philippson and Bahuchet, 1996). As Vansina (1980: 312–13) commented many years ago, ‘any and all of the forces sociolinguists have discovered may have operated at different times in different places and with different intensities. It is not certain at all that any population explosion was ever needed to account for this spread, nor is the contrary—the extinction of aboriginal populations—a necessary implication of the Bantu language spread.’

This is not to suggest that population movements were not part of the process by which domesticates and their use spread southwards. Microsatellite loci in fifty indigenous cattle breeds indicate that domestic cattle probably spread southwards down the eastern side of South Africa (Hanotte *et al.*, 2002). A study of mtDNA in sixteen Bantu-speaking groups in South Africa (focused on Mozambique) indicated high homogeneity and considerable mobility, in particular a complex series of short-distance movements rather than a single migration (Salas *et al.*, 2002). Low geographical differentiation in Y-chromosome data suggests relatively recent origins for a series of Bantu lineages, as well as a significant degree of Bantu/Khoisan admixture (Cruciani *et al.*, 2002). Jobling *et al.* (2004: 328), however, emphasize the tentative nature of much of this work, the limited nature of sampling programmes of the human populations in particular, and the ambiguities of current definitions of populations and ethnic groups on which sampling programmes (and the interpretations drawn from them) are based.

The recent ethnography of Africa shows that most farmers combined farming with foraging, and most herders also farmed and foraged, with both groups shifting the balance of their activities in response to changing needs and circumstances (Mace, 1993). There was a wide variety of social and economic relations, both peaceful and hostile, between foraging, herding, and farming societies (Cashdan, 1984). Foragers were less likely to adopt agriculture the closer they were to farmers, because a good strategy in the face of resource stress was to broaden foraging systems (taking new plants and aquatic species, practising controlled burning, protecting and transplanting plants, and so on), in part to try to raise food supplies for themselves but also to obtain more products for trade with neighbouring farmers for food

(Hitchcock and Ebert, 1984). There are other examples of foragers turning to farming—albeit with regret and misgivings—in bad times when game was scarce and grazing was being depleted by the stock of neighbouring, better organized, and more powerful, farmers (Brooks *et al.*, 1984). Switching to farming has had advantages for some Kalahari foragers, though, allowing people to stay in large groups for longer, reducing the number of residential moves (Cashdan, 1984). The kaleidoscope world of recent African ethnography has more to tell us about the likely complexity of transitions to and from farming in the African continent (with implications for other parts of the world, I suspect) than simplistic models of migrating farmers and herders, or indeed of an alternative model of a one-way process of foragers turning to farming (Reid, 1996).

Bantu migration theories were grist to the mill of the Republic of South Africa's apartheid politics, because they emphasized the apparently separate histories of Bushmen, Hottentot, and Bantu races. The cornerstone of Afrikaans' mythology, for example, was that Boer farmers and Bantu farmers arrived at the Cape more or less at the same time, thus giving the former as much right to the land as the latter. Similar mythologies about historic differences between Bantu and non-Bantu peoples have also become accepted lore amongst many indigenous African populations, often with disastrous consequences such as the 1990s massacres in Rwanda. The Tutsis believe themselves to be derived from Nilotc cattle-herders, the Hutu from Bantu farmers. In fact there is very little to distinguish the two groups, and the Nilotc/Bantu dichotomy is a mistaken creation of nineteenth- and earlier twentieth-century scholarship concerned with identifying ethnic differences in the archaeological record, the effects of which, as we have seen in this chapter, still resonate through the debate on transitions from foraging to farming in Africa. A note left with a group of European tourists killed in Bwindi National Park in Uganda by Hutu guerillas in 1999 read in broken French 'here is the fate of all the Anglo-Saxons who betray us to the Nilotics against the Bantu cultivators' (Hannan, 1999). Africa more than any other continent needs the richness, diversity, and complexity of its archaeological past, especially the archaeology of its foraging-farming prehistory, bringing to the public and political arena (Hall, 1996).

9

Transitions to Farming in Europe: *Ex Oriente Lux?*

INTRODUCTION

Ever since the speculations of the Victorians about the inexorable progress of Man from the savagery of foraging to agriculture and civilization, Europe has been one of the main theatres of debate about transitions from foraging to farming (Chapter 1). The dominant model in the twentieth century, first developed explicitly by Gordon Childe in *The Dawn of European Civilization* (1925) and *The Danube in Prehistory* (1929), has been that of *ex oriente lux*, ‘light from the Near East’. According to this theory, farming began in Europe because it was introduced by Neolithic farmers from South-West Asia, who brought with them domesticated plants and animals together with a new technology that included pottery and polished stone tools. They colonized a land thinly occupied by Mesolithic foragers except at the coastal margins. In southern Europe, the first farmers would have ‘taken to their boats and paddled or sailed on the alluring waters of the Mediterranean to the next landfall—and the next’ (Childe, 1957: 16). In temperate Europe, expansion was facilitated by ‘slash-and-burn’ (swidden) agriculture practised by the first farmers: they arrived at a particular location, cleared the forest, burnt the cut timber, and planted their crops, and then moved on after a few years.

The first suite of 14C dates from European Neolithic sites obtained in the 1960s astonished archaeologists, because the (uncalibrated) dates of c.6000 BC from Greek Neolithic settlements such as Nea Nikomedea and Knossos (Fig. 9.1) were 3,000 years older than Childe’s suggested date for the beginning of the European Neolithic: c.3000 BC. He established the latter by an elaborate process of cross-dating European prehistoric sites with historically dated cultures in the eastern Mediterranean, in turn dated by links to Pharaonic Egypt. At the same time, the 14C data appeared to confirm Childe’s *ex oriente lux* theory, because there was a clear trend of increasingly younger dates with distance from South-West Asia (J. G. D. Clark, 1965; Fig. 1.7). The dates of c.6000 BC in south-east Europe were in the same time-frame as dates for PPNB

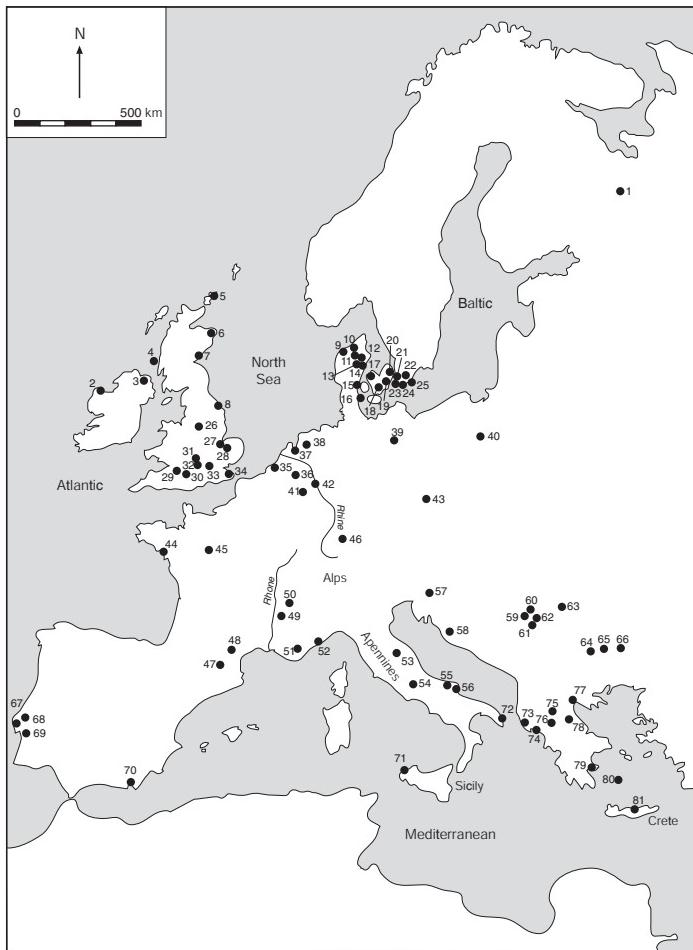


Fig. 9.1. Europe, showing principal regions and sites mentioned in Chapter 9 (for Cypriot sites Aetokremnos, Mylouthkia, and Shillourokambos, see Fig. 4.1).

Sites: 1. Olenii Ostrov; 2. Behy (Céide); 3. Mount Sandel; 4. Colonsay, Oronsay; 5. Knap of Howar; 6. Balbridie; 7. Morton; 8. Star Carr; 9. Aggersund; 10. Bjørnholm; 11. Ertebolle; 12. Meilgaard; 13. Dyrholmen; 14. Ringkøster; 15. Tybrind Vig; 16. Als; 17. Saltbael Vig; 18. Øgarde; 19. Ølby Lyng; 20. Vedbaek; 21. Løddesborg; 22. Agerød; 23. Mossby; 24. Skateholm; 25. Ystad; 26. Lismore Fields; 27. Etton, Fengate; 28. Haddenham; 29. Somerset Levels; 30. Hambledon Hill; 31. Crickley Hill; 32. Knap Hill, West Kennett, Windmill Hill; 33. Thatcham; 34. White Horse Stone; 35. Doel; 36. Elsloo, Geleen, Sittard; 37. Swifterbant; 38. Jardinga; 39. Friesack; 40. Brzész Kujawski; 41. Aldenhovener plateau; 42. Köln-Lindenthal; 43. Bylany; 44. Hoëdic, Téviec; 45. Noyen; 46. Talheim; 47. Balmi Margineda; 48. Balma Abeurador; 49. Campalou; 50. La Fru; 51. Fontbrégoua; 52. Arene Candide; 53. San Marco; 54. Grotta Continenza; 55. Grotta Paglicci; 56. Tavoliere sites—Coppa Nevigatta, Passo di Corvo; 57. Sebrn; 58. Smilčić; 59. Vinča; 60. Starčevo; 61. Divostin; 62. Selevać; 63. Iron Gates—Icoana, Lepenski Vir, Padina, Schela Cladovei, Vlasać; 64. Chevdar; 65. Kazanluk; 66. Karanovo; 67. Tagus estuary; 68. Caboço da Arruda; 69. Sado estuary; 70. Fuente Alamo, Gatas; 71. Grotta dell'Uzzo; 72. Grotta Romanelli; 73. Sidari; 74. Asfaka; 75. Klithi; 76. Kastritsa; 77. Nea Nikomedea; 78. Achilleion, Argissa, Makriyalos, Sesklo; 79. Franchthi Cave; 80. Melos; 81. Knossos

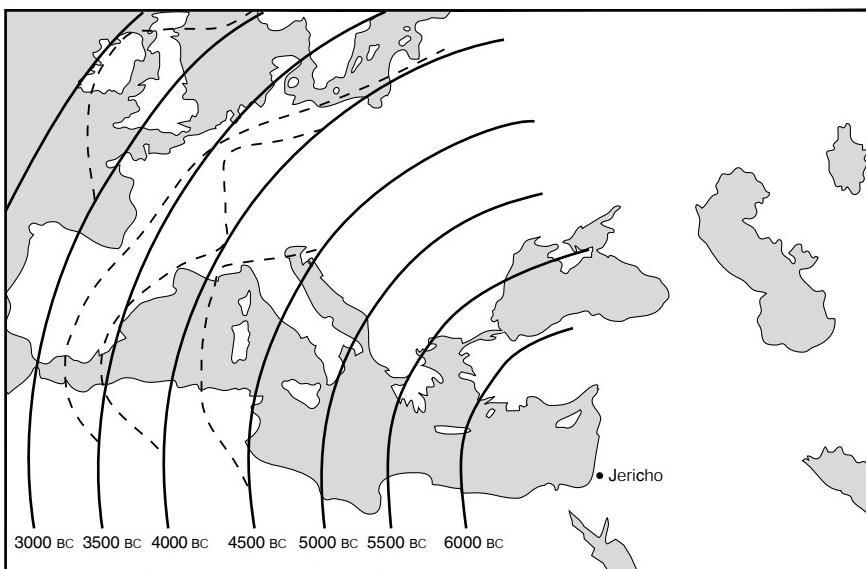


Fig. 9.2. The 'wave of advance' of Neolithic farmers across Europe according to Ammerman and Cavalli-Sforza's interpretation of 14C dates in 1971 (after Barker, 1985: fig. 5)

Neolithic settlements in South-West Asia, dates in central Europe and the Mediterranean were of the order of 4500 bc, and dates from Early Neolithic sites on the Atlantic margins of Europe were nearer 3000 bc.

The *ex oriente lux* model was further refined by Ammerman and Cavalli-Sforza in 1971, who calculated that the larger number of dates from Neolithic sites by then available indicated a 'wave of advance' of Neolithic farmers moving across Europe from the south-east to the north-west at an average rate of just over a kilometre a year (Fig. 9.2). A further dimension was added to the model by Renfrew's argument that Neolithic farmers from South-West Asia were the mechanism by which the Indo-European languages (or rather, a proto-language from which the later languages developed) spread into Europe (Renfrew, 1987). As the archaeological record improved, however, it frequently failed to fit the neat predictions of the *ex oriente lux* model. Some Early Neolithic sites had the 'full Neolithic package' of pottery, polished stone tools, and domesticated plants and animals. At others, Neolithic pottery was associated with forager lithic technologies and bones of wild animals, or with mixed technologies and subsistence data suggesting a mix of foraging and farming. There were many regions where the data could be explained more easily in terms of acculturation, whereby European foragers invented farming and/or adopted it through contact with farmers, than in terms of the arrival of

a new people (Barker, 1985; Dennell, 1983; Whittle, 1996; Zvelebil, 1986a). A common view today is that colonization was the dominant process in south-east Europe and acculturation elsewhere (e.g. Gkiasta *et al.*, 2003; Price, 2000).

The debate has certainly been bedevilled by questions of terminology. Implicit in the traditional classifications of the Mesolithic and Neolithic Ages bequeathed to us by the Victorians has been a notion of two discrete periods defined by distinct bodies of material culture representing contrasting societies and lifeways: a Mesolithic Age of mobile ('nomadic' usually) hunter-gatherers using flake axes and microliths; and a Neolithic Age of settled farmers using polished axes, blade tools, pottery, and farming. This Mesolithic/Neolithic 'dichotomy' continues to provide the dominant framework for university courses in archaeology, textbooks, conferences, and academic careers. Yet virtually every detailed regional study of prehistoric settlement in Europe over the past thirty years or so has shown that the archaeological record cannot be divided simply and neatly in this way. Understanding the transition from foraging to farming in Europe has to encompass the challenging complexity of the Mesolithic/Neolithic archaeological record. This in turn has to be understood against the background of life in Europe in the closing millennia of the Pleistocene, the subject of the next section.

LATE PLEISTOCENE SETTLEMENT

In the extreme conditions of the full glacial, when for example the northern half of Britain was entirely under ice (almost 2,000 metres thick over central Scotland), large areas of Europe were more or less abandoned by people. Upper Palaeolithic foragers retreated to 'rifugia' areas such as south-west France and northern Spain, northern Italy, parts of the Balkans and central Europe, and selected valleys in the Ukraine and the central Russian plain (Soffer and Gamble, 1990; Straus *et al.*, 1996; Street and Terberger, 1999). This process of population packing was the context for the development of more complex social relationships and ideological structures than hitherto (Gamble, 1999; Jochim, 1998). In the millennia following the Last Glacial Maximum, people rapidly repopulated Europe (R. Charles, 1996; Housley *et al.*, 1997; Street and Terberger, 2002). The archaeological evidence is supported by inferences from the patterning of genetic diversity in modern populations for the antiquity and direction of movements at that time (M. Richards and Macaulay, 2000; Richards *et al.*, 1996; Torroni *et al.*, 1998).

It was recognized early in the history of Palaeolithic studies that many Upper Palaeolithic sites, particularly the famous caves of the Dordogne in

south-west France, contained large quantities of reindeer and horse bones, suggesting that these animals were intensively hunted. The reliance on these animals increased significantly during and after the LGM. From a study of reindeer teeth and antler in the Dordogne caves, Bouchud (1966) argued that Upper Palaeolithic foragers (known archaeologically as the Magdalenian culture) camped here to intercept reindeer herds during the latters' presumed migrations between wintering areas on the Atlantic and summer pasturing areas in the Massif Central. Sturdy (1975) suggested instead that Magdalenian people were herd-followers rather than intercept hunters: they followed the herds in their annual migrations between summer grazing areas in the German and Swiss uplands and winter grazing areas between the lower Rhine and lower Elbe, a distance of some 600 kilometres. He drew explicit parallels with the modern Lapp herding systems he had studied in Greenland (Sturdy, 1972; see Chapter 2, p. 68). Bahn (1977, 1978, 1980) went further, and postulated that Magdalenians were taming and riding horses as well as herding reindeer. He noted instances of rope-like features on depictions of goats and reindeer, possible bridles on images of horses, and pierced antler staffs (*bâtons de commandement*) that could be bridle cheek-pieces. Some ungulates appeared to have been killed by pole-axing. Healed fractures in ungulate bones implied human care of injured animals. Some antlers came from castrated male reindeer. There were examples of bevelled horse incisors, which are rarely found in wild horse populations but which domestic horses acquire from crib-biting.

Such theories were greeted with considerable scepticism (R. White, 1989). It was pointed out that herd following was not feasible because reindeer could move so much faster than people over landscapes such as tundra (Burch, 1972). Detailed analyses of reindeer faunas in France indicated that reindeer were killed singly or in small numbers through the late autumn, winter, and early spring, evidence clearly difficult to reconcile with the migration model (Enloe, 1993; Speiss, 1979). 'Bridle' marks were found on images of bison as well as reindeer, and identifying them amidst all the other lines and scratches was very much an act of faith (Fig. 9.3). *Bâtons de commandement* need not be bridle pieces. Many animals recover from gross fractures in the wild. Pole-axed skulls could be animals wounded in the hunt that were then dispatched at close quarters. The few antlers from castrated reindeer contrasted with the tens of thousands of antlers from normal males, and were probably the result of accidents or hormonal deficiencies. Chewing tree bark could produce the same effects on horse incisors as crib-biting.

The consensus today is that there was specialization in late glacial hunting techniques, and on concentrated seasonal harvesting, but not specialized hunting in the sense of a focus on one species over all others, nor Lapp-like reindeer herding (Audouze, 1987; Kuhn and Stiner, 2001). There was

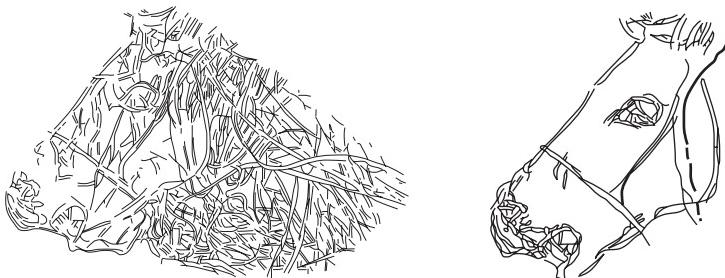


Fig. 9.3. Engraved horse head from La Marche: drawings of (*left*) all the incised lines visible on it, and (*right*) the putative bridle identified by Paul Bahn (1978) (after R. White, 1989: fig. 2)

considerable diversity in hunting systems, related to the prey opportunities of the particular locality and season. Many foragers in northern Europe in the late Pleistocene certainly practised intercept killing of migrating reindeer herds, but they also combined this with encounter hunting of reindeer during periods of herd dispersal (Weinstock, 2002), and they made use of many other sources of food (Burke, 2000; Fontana, 1995; Gordon, 1988; Straus, 1993; Weniger, 1987). Some bands probably did practise herd following, but seasonal shifts from encounter to intercept hunting allowed others to remain in restricted territories throughout the year (K. Boyle, 1996; Burke, 2000; Olsen, 1995). Probably most Magdalenian foragers concentrated on killing reindeer during the spring and autumn migrations, drying or caching the meat, but in between also hunted reindeer and other game on an encounter basis, collected shellfish if they had access to coastal shores, fished (to a limited extent, as far as we can tell), and collected edible plant food such as berries.

Specialized hunting and herd-following were also proposed for southern Europe, with respect to red deer and *Equus hydruntinus* (the steppe horse, a donkey-like animal), with a particular focus on seasonal movements between coastal lowlands and the interior mountains in Greece (Higgs *et al.*, 1967), Italy (Barker, 1975, 1981), and Spain (Davidson, 1976). As in the reindeer case, however, more recent detailed archaeozoological analyses suggest the same sort of complexity in hunting strategies as in northern Europe, though within a general framework of upland–lowland movement. Kastritsa, for example, in the mountains of Epirus in north-west Greece, was used especially for intercept hunting of red deer, but numerous other species such as cattle, horse, and hare were also killed, as well as waterfowl (G. N. Bailey, 1997; Kotjabopoulou, 2001). It was probably a summer base camp occupied by a mixed band of men, women, and children for several months a year. By contrast, the Klithi rock shelter nearby was used just for a few days each summer for hunting ibex and

chamois. In the foothills and mountains of northern Italy, there were complicated movements between camps at different elevations to hunt red deer, ibex, chamois, and other species (Phoca-Cosmetatou, 2001). On the lowlands of southern Italy, the Grotta Paglicci and Grotta Romanelli caves were specialized winter hunting stands within logistical systems of seasonal hunting (Biondi, 1995; Donahue, 1988; Fiore and Curci, 1995). The La Fru and Campalou rock shelters in southern France were used for the opportunistic hunting of red deer, the former with a focus on the summer herds of hinds and their young, the latter on these and also, in the early autumn, of males during the rut. Ibex, chamois, roe deer, and marmot were also hunted from and consumed at these two sites, whereas the meat of the red deer was processed and taken elsewhere for consumption (H. Martin, 1998). In northern Spain, Late Upper Palaeolithic subsistence focused on red deer, though horse, bovids, ibex, and chamois were also important along with marine foods such as shellfish (G. N. Bailey, 1983c; G. A. Clark and Straus, 1983).

In both northern and southern Europe, therefore, the evidence of prey specialization at particular locations, and the varied nature of the kills, indicate highly efficient hunting techniques, effective hunting strategies, and well-organized task groups. Late glacial subsistence technologies included: hunting with the stabbing spear, the throwing spear, the bow and arrow, and the trap; caching, drying, and smoking food, and rendering grease by boiling; wearing multi-piece sewn clothing; and using sleds and snow-shoes (Dennell, 1983; Kuhn and Stiner, 2001). Good intelligence in such extreme environmental conditions was clearly essential for survival, and painted caves became, in part, repositories of hunting lore and experience: the images show not only different species of animals and birds (and of different types such as young, old, male, healthy, and sick), but also their tracks, hoof-prints, and dung (Mithen, 1990). These were highly complex societies: age and gender differences were carefully marked, as well as kin affiliations (Pluciennik, 1998).

Whilst the theory of Late Upper Palaeolithic ‘proto-herding’ in Europe is now discounted, it is important not to approach the archaeological record with a priori assumptions about what these foragers could or could not do, and about particular animals being ‘inherently wild’ or ‘inherently domesticable’. Reindeer can certainly be managed successfully today, as in the Lapp systems that mix wild/less managed and domesticated/more managed individuals (Chapter 2, pp. 68–9). Wild red deer on the Scottish island of Rhum come to feeding points at the sound of a vehicle horn (Barker, 1985: figs 14 and 15; and Fig. 10.2). There is an eighteenth-century record of an eccentric British lord having his carriage pulled by red deer (Wilkinson, 1972: 115). Moreover, whilst late Pleistocene foragers in Europe probably did not ride horses or herd animals, it is likely that they shared their lives with domestic dogs, valuing

them for their companionship as well as for their use in transport and hunting (Müller, 2005; Musil, 1970). Living with a domesticated animal was, therefore, probably already a component of Palaeolithic lifeways in Europe in the closing millennia of the Pleistocene.

DEGLACIATION AND ITS CONSEQUENCES

More or less modern temperatures (at least in terms of summer averages) developed in Europe between c.12,700 and 10,800 BC (the Bølling and Allerød interstadial), but there was then a sharp return to cold conditions, the Younger Dryas stadial (*c.*10,800–9600 BC: Fig. 4.5), before the shift began properly towards the modern climatic conditions of the Holocene. Weather shifts through the dramatic temperature fluctuations of the late Pleistocene and early Holocene (with changes of several degrees within a century, sometimes) were particularly marked in western Europe, exposed as it was to both Atlantic and continental weather systems. The polar front, for example, (the boundary between cooler waters flowing southwards from the arctic and the Gulf Stream waters flowing northwards), shifted from the latitude of Portugal at the LGM to Iceland in the Late Glacial stadial, then back to Portugal in the Younger Dryas, before moving north once more to stabilize in the early Holocene around its present position north of Iceland. The climatic shifts caused dramatic changes to the European landscape and its flora and fauna, changes so rapid and so sweeping that, even if one generation of the human population did not notice them within their lifetime, they must have been noticeable in terms of the memories handed down by, say, their grandparents. The successive reconfigurations of the European landscape through the late Pleistocene and early Holocene caused by glacier retreat and sea-level rise are dramatically illustrated by the gradual emergence of Britain and Ireland from the North Sea (Fig. 9.4).

As the climate warmed and precipitation increased, deciduous species such as oak and lime rapidly expanded their ranges, broadly from the eastern Mediterranean westwards and northwards. The vegetation succession is best understood in north-west Europe as a result of thousands of pollen core studies, on the evidence of which palynologists have been able to define a series of distinct vegetation zones or phases that are taken to be proxy indicators of climatic shifts (Table 9.1). In southern Europe the vegetation succession reflected changes in precipitation more than temperature. Pine then oak forest spread across the Mediterranean, with pine then colonizing higher elevations and oak forest the lowlands, though the driest areas probably remained open parkland.

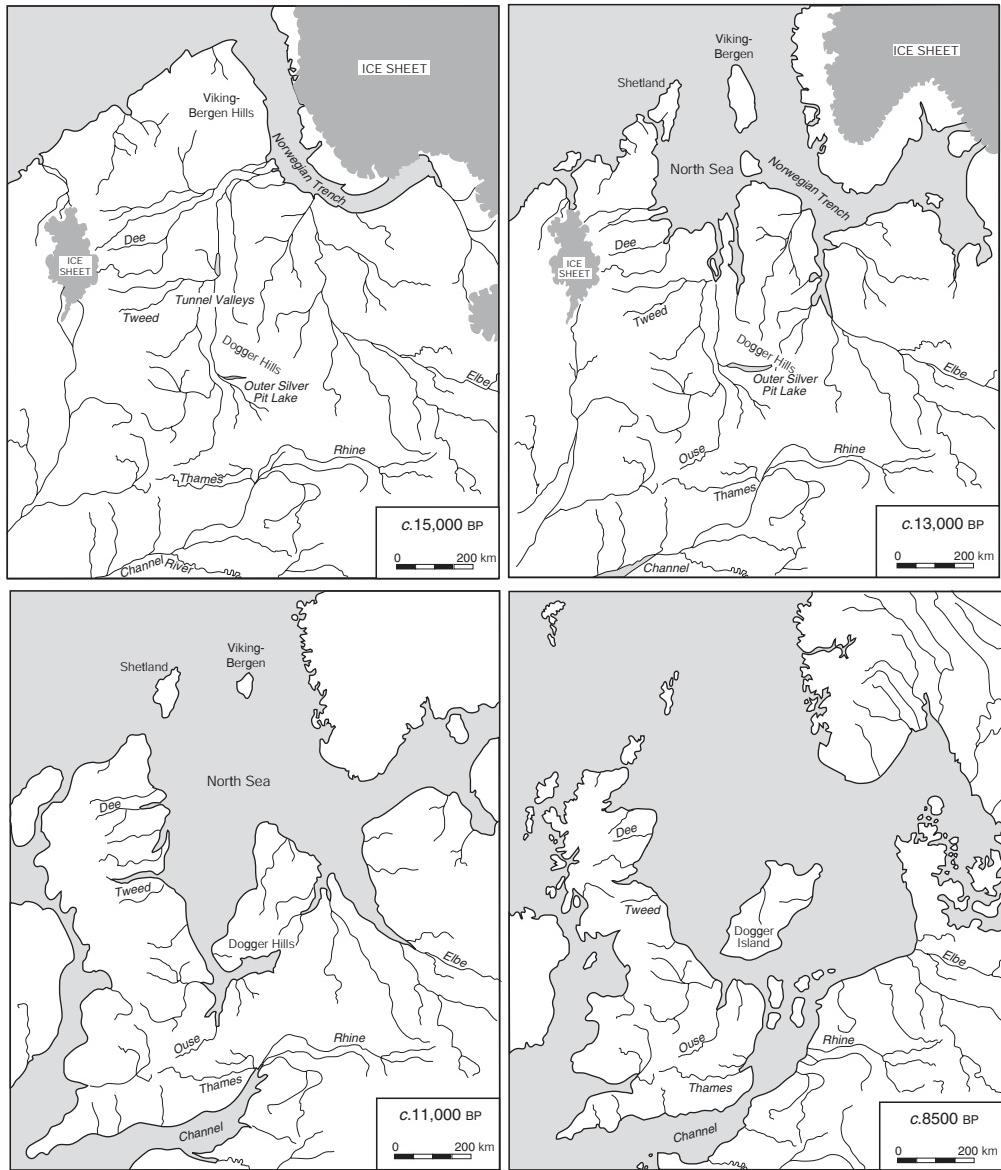


Fig. 9.4. The landscape transformations of the late Pleistocene and early Holocene, north-west Europe: (a) c.15,000 BP; (b) c.13,000 BP; (c) c.11,000 BP; (d) c.8500 BP. 'Dogger island' and the islands shown to its south were submerged by later sea-level rise (after B. J. Coles, 1998: figs. 8, 9, 10, and 11)

Table 9.1. The vegetational succession (and its climatic implications) in north-west Europe from the late Pleistocene to the Holocene, as established by pollen analysis

Pollen zone number	Pollen zone name	Dominant vegetation	Climate	Date bc (approximate)
IX	Sub-Atlantic	Beech	Maritime	After 1000
VIII	Sub-Boreal	Oak, beech	More continental	4000–1000
VII	Atlantic	Oak, elm, hazel	Warmer, maritime	6000–4000
VI	Boreal	Pine, hazel, oak	Warmer, continental	7000–6000
V	Boreal	Beech, pine, hazel	Warmer, continental	8800–7000
IV	Pre-Boreal	Beech, pine, juniper	Warm, continental	9600–8800
III	Younger Dryas	Forest tundra	Arctic	10,800–9600

The more forested landscapes favoured smaller ungulates such as red deer, roe deer, aurochs, elk, and pig, rather than the great herds of reindeer and horse and the megafauna of the Pleistocene tundras. These animals were less migratory and lived in much smaller herds, in some cases for much of the year as solitary individuals. There was an increasingly rich and diverse fauna of smaller mammals, species such as beaver, otter, hare, pine marten, badger, and fox. In the warmer and biologically richer seas fed by the Gulf Stream were populations of whales, porpoises, sharks, and dolphins, and a wide range of fish. At the seashore, tidal flats, rocky shores, and estuaries supported a wide diversity of waterfowl, fish, edible crustaceans, and molluscs. Inland, many parts of Europe, north of the Alps especially, were watery as well as forested landscapes, the rivers and lakes providing habitats for fish such as pike, tench, and bream, and waterfowl. The landscape also offered an infinitely richer range of edible plant foods for foragers—between 200 and 450 species (Clarke, 1976)—than the late Pleistocene tundras (Zvelebil, 1994). In temperate Europe these included nuts such as hazelnuts and water chestnuts, berries such as blackberry, fruits such as crab apple, plum, and pear, seed grasses such as *Chenopodium album* (Fat hen), and edible wetland plants such as waterlily, reed, and bog bean. In southern Europe the main plant foods available were seeds, pulses, and nuts.

Early and mid-Holocene Europe was thus characterized by far more diverse and complex ecologies than late Pleistocene Europe, marked not only by considerable variation in terms of how edible plants and animals were distributed but also by distinct seasonal fluctuations in abundance. In general, the richest locations for Holocene foragers in terms of the overall diversity and availability of food would have been coasts, estuaries, lakes, and rivers, rather than interior regions. The result was that Mesolithic populations concentrated in the former, which in some instances became arenas of dramatic social

intensification and cultural florescence, whereas settlement was much sparser in the latter.

EARLY HOLOCENE FORAGING ‘SEASCAPES’ IN SOUTHERN EUROPE

In proposing his model of agricultural colonization by Early Neolithic sea-going farmers using Impressed Ware (also termed Cardial Ware from being decorated with shells of the cockle *Cardium edule*), Gordon Childe was certainly right to regard the Mediterranean sea as a means of communication rather than as a barrier, but that was as true for early Holocene foragers as it was for later agricultural societies. Several coastal cave sites have fish bones of deepwater species that must have been caught offshore from watercraft, but there is also evidence of longer more purposeful sea crossings. Foragers were making journeys to the island of Cyprus, a minimum voyage of some 70 kilometres from mainland Asia, from as early as the ninth millennium BC, where they may have been responsible for the extinction of the indigenous pygmy hippopotamus *Phanourios minutus* and pygmy elephant *Elephas cypriotes* (Peltenburg *et al.*, 2000; Reese, 1996; A. H. Simmons, 1998). There are fragments of obsidian from the small Aegean island of Melos in late Pleistocene and early Holocene contexts in Franchthi Cave on the coast of mainland Greece, over 100 kilometres away. In the west Mediterranean early Holocene foragers may have visited the Balearic islands from time to time in order to hunt the indigenous endemic goat there, *Myotragus balearicus* (Lewthwaite, 1989; Ramis and Alcover, 2001; Ramis *et al.*, 2002). They certainly visited Corsica and Sardinia, probably especially to hunt the endemic lagomorph (hare) *Prolagus sardus* (Vigne, 1987). Sailing expertise capable of dealing with the Mediterranean currents, tides, and winds must have facilitated a common ‘seascape’ of cultural contacts and shared behaviours (Rainbird, 1999).

Franchthi Cave is one of the best studied Mesolithic sites in the Mediterranean (Jacobsen, 1973, 1976, 1981). It is an impressive cavern facing out to sea, a few metres above sea level, on the coast of the north-eastern Peloponnese in Greece. By the beginning of the Holocene the sea was some 25 metres below the cave, and the coast two kilometres away (van Andel and Runnels, 1987). Like their late Pleistocene antecedents, people using the cave in the early Holocene hunted red deer (in particular), aurochs, pig, and a variety of smaller game, collected shellfish, and fished, but unlike the late Pleistocene occupants they also gathered plants intensively. Along with numerous grindstones, the excavators recovered by intensive flotation some 28,000 seeds from 27 species, compared with some 700 seeds from far fewer species in the late Pleistocene

deposits (Hansen, 1991, 1992). The primary species represented are oats, lentils, pistachio, and almond, with smaller quantities of barley and various legumes. Similar evidence for hunting, fishing, and plant gathering (again including wild barley and legumes) has been found in the Grotta dell'Uzzo cave on the northern coast of Sicily (Cassoli and Tagliacozzo, 1997; Tagliacozzo, 1994; Tusa, 1996). Legumes have also been reported from Fontbrégoua and Abeurador in southern France, though there are now doubts about their association with Mesolithic foragers (Binder 2000: 120; Vaquer *et al.*, 1986).

The cereals and legumes found in the Mesolithic occupations of Franchthi and Grotta dell'Uzzo are all morphologically wild, but it is impossible to judge whether people were gathering these plants as wild stands, or were tending or cultivating them in some way. Harvesting wild, semi-cultivated, or cultivated cereals by beating grains into a bag or basket would have consistently selected for brittle-rachis seeds, yielding more or less identical archaeobotanical samples. The evidence could be interpreted in terms of incipient or primitive plant husbandry being practised at this time (Dennell, 1983), though the balance of probability is that cereals and legumes were being gathered from unmanaged wild stands (Hansen, 1992). Whatever was going on (and of course, both scenarios are possible), it is apparent that several cultivars long regarded as endemic to South-West Asia but exotic to the Mediterranean, and thus traditionally assumed to have been introduced by Neolithic farmers, were in fact native to the Mediterranean and were recognized by the indigenous population of foragers as a useful source of food from the beginning of the Holocene.

Wild goats (ibex) were native to the Mediterranean in the late Pleistocene and early Holocene, and although today they are restricted to high mountains such as the Alps of the Italian–Swiss border, the archaeological evidence shows that they were then much more widespread, at lower elevations (Phoca-Cosmetatou, 2001). On ecological grounds it is also quite possible that the distribution of wild sheep in the late Pleistocene likewise extended westwards from South-West Asia. Bones of domestic sheep have been reported from time to time from early Holocene sites in the Mediterranean, especially the central and western parts, giving rise to discussions of the possibility of sheep being domesticated here, or at least semi-managed in some way, by Mesolithic foragers (Geddes, 1985). Another theory to explain bones of domestic sheep in Mesolithic sites in the central and western Mediterranean has been that foragers there obtained domestic sheep as an exotic or prestige item by trading with farmers to the east (Lewthwaite, 1986). Arguments for *in situ* domestication have generally not been accepted by Mediterranean prehistorians (e.g. Binder 2000; Zilhao 1993, 2000), particularly because much of the contextual evidence is problematic: some bones from Mesolithic sites once identified as

of domestic sheep have turned out to be, on re-examination, definitely of ibex, and at many sites the likelihood of stratigraphic disturbance is high, for example from burrowing animals, so it is quite likely that many ‘Mesolithic sheep’ are in fact sheep bones from later contexts. However, given the unequivocal evidence for Mesolithic foragers corralling and feeding wild Barbary sheep in caves in the Libyan Sahara a thousand or so years before the introduction there of the domestic sheep (Chapter 8, p. 295), it would be very unwise to assume with complete certainty that sheep and/or goats were not part of the early Holocene Mediterranean landscape, and therefore of Mesolithic foragers’ lifeways here. The jury would be wise to stay out.

Through the seventh millennium BC, there are indications at Franchthi Cave of more intensive, multi-seasonal, use, as well as the cave being used for burials. There was an increasing emphasis on shellfish collection and fishing, especially for tunny, the size of the fish suggesting that people may have practised cooperative hunts using watercraft and nets. The Grotta dell’Uzzo, too, was used more intensively by the seventh millennium BC, with fishing and shellfish collection increasingly important. There were parallel developments in the Iberian peninsula, people concentrating in quite substantial settlements along the margins of the major river estuaries such as the Tagus, Sado, and Mira (Fullola and Garcia-Argüelles, 1996; Zilhao 2000). Both the food refuse from these occupation sites and the body chemistry of the people buried there show a major focus on estuarine and marine foods (Lubell *et al.*, 1994; Stiner *et al.*, 2003). The trend may in part reflect the rising sea levels of the mid-Holocene ‘climatic optimum’, bringing such foods nearer to coastal caves such as Franchthi and Uzzo, compounded by the impact on terrestrial resources of the expansion of forests at that time. However, the dietary shifts also coincide with indications of increased sedentism and (on the evidence of burials) increased social differentiation.

Contemporary foraging in the interior regions of Greece, Croatia, Dalmatia, Italy, southern France, and Spain sustained smaller, more mobile, populations. Typical of their sites is the Grotta Continenza in the Italian Apennines, used occasionally for hunting forest and mountain game, catching waterfowl, and collecting edible snails (Martini and Tozzi, 1996). Sebrn in the mountains of Croatia is another example of a seasonal deer-hunting camp (Miracle *et al.*, 2000), and the Balmi Margineda rock shelter 1,000 metres up in the Pyrenees is another (Geddes *et al.*, 1989). In northern Italy there are numerous summer camps high in the Alps and Apennines (Broglio 1992, 1996; Lanzinger 1996), but the scale of activity caused minimal disturbance to the landscape (Biagi *et al.*, 1994). The interior regions of the Mediterranean seem to have sustained rather sparse, residentially mobile, presumably egalitarian, hunter-gatherers through the early Holocene, in contrast with the development in many coastal

locations of what seem to have been more sedentary and more socially differentiated communities linked by sizeable social networks of kin-based contact and exchange (Skeates, 2000; Zvelebil, 1996a).

BOREAL AND ATLANTIC FORAGING IN TEMPERATE EUROPE

As J. G. D. Clark (1936) first pointed out, the Mesolithic of Europe north of the Alps divides into an earlier and a later phase, the former correlating broadly with the Pre-Boreal and Boreal climatic/vegetation phases and the latter with the warmer and moister Atlantic phase that developed after c.6500 BC.

Star Carr in Yorkshire (England) remains the best known and probably the most intensively studied Early Mesolithic site in temperate Europe. The original excavations found a platform of birch trunks covered in stones, clay, and moss as some kind of living platform, placed on waterlogged ground at the edge of a lake a few kilometres inland from the sea (Clark, 1954). On and around it was an array of well-preserved artefacts including flint flaked axes and adzes, flint microliths, barbed points of red deer antler, antler mattocks, a wooden paddle (dug-out canoes of the period survive elsewhere in Europe), birch bark rolls, and most intriguing of all, a red deer skull cap with its antlers attached and pierced as some kind of headdress. The faunal sample consisted of forest fauna (especially red deer, but also aurochs, elk, roe deer, and pig) and many species of water birds, together with the domestic dog. The shedding ages of deer antler indicated that the site was probably occupied in the autumn (Fraser and King, 1954).

In a major reassessment of the site in 1972, Clark argued that it was probably some kind of autumn/winter base camp for a Mesolithic band of 3–4 families who hunted game in the lowland forests during the winter and then dispersed into adjacent hills in the summer, following herds of red deer. Later studies posited other theories, for example that it was an all-year-round hunting site (Jacobi, 1978), a bone-working location (Pitts, 1979), and an ambush location for intercept hunting (Andresen *et al.*, 1981). More convincingly, Legge and Rowley-Conwy (1988) argued from a careful review of the killing ages of the animals that the primary occupation period was spring/summer, and from analysis of the body parts that it was probably a hunting camp used by a few hunters for a few days or weeks each year for processing the carcasses of game killed elsewhere, for transport back to the home community at the base camp. Their activities at Star Carr certainly had minimal impact on the landscape: they may have practised burning the lake-edge vegetation, for example, but the fires do not register as charcoal in sediment cores taken just 200 metres away (Cummins, 2000).

This boggy camp, used occasionally 9,500 years ago for a couple of weeks by a handful of people, remains the subject of intensive research and debate (Carter, 1998; Mellars and Dark, 1998). The bone chemistry of a dog suggests that it ate mainly marine foods, indirect evidence that its owners moved seasonally between Star Carr and the sea 10–15 kilometres away (Clutton-Brock and Noe-Nygaard, 1990; Schulting and Richards, 2002a). Further fieldwork has found more Mesolithic camps around the lake, and the mutual inconsistencies of the seasonality data at Star Carr and the range of the material culture suggest that people were camping by the lowland lakes for different purposes at different times of the year (Conneller and Schadla-Hall, 2003).

This model accords with evidence of other Boreal-period lowland sites in Britain. Summer and winter occupation has been postulated for a cluster of small huts interpreted as single-family shelters at Mount Sandel in northern Ireland (Woodman, 1985). There was a typical forest fauna, a wide variety of waterbirds, quantities of fish bone (mainly salmon, sea trout, eel, and bass), and caches of hazelnuts. Thatcham in Berkshire (southern England), an inland lakeside camp, has a similar range of food refuse as Star Carr but is interpreted as a base camp location repeatedly visited by Boreal foragers (C. Smith, 1992: 124). The model of winter aggregation on the lowlands of northern England and summer dispersal to the adjacent uplands is too simplistic (Spikins, 2000): people operated in small bands in flexible and mobile logistical systems, perhaps aggregating when food resources allowed it (the latter occasions no doubt important for intra-band social interaction, the exchange of marriage partners, and so on). The landscapes they inhabited were as much cultural/symbolic as economic. Intriguing decorated posts appear to have been some kind of territorial markers symbolizing sacred geographies that probably persisted over many generations (M. Allen and Gardiner, 2002).

Similar patterns of mobile foraging by small dispersed communities have been proposed for other parts of temperate Europe at this time. Single-family dwellings appear to have been the norm at Maglemosian sites in southern Scandinavia (Grøn, 2003). One such site, Agerød in Scania (southern Sweden), was a lakeside camp used in the summer by a small foraging group who probably spent the winter on the coast (Larsson, 1983). A riverside locale at Noyen in the Seine valley in northern France was visited regularly through the summer by people who came to hunt game or trap and smoke eels (Mordant and Mordant, 1992). Friesack on the north German plain was another summer foraging camp; the artefacts that survived in the waterlogged sediments including arrows, a bow, spears, digging sticks, nets, and baskets (Gramsch and Klosch, 1989). At Tybrind Vig in Denmark there was an arrow embedded in an aurochs' skeleton, and at other Danish sites healed wounds have been noted on elk and red deer bones at a number of locations (as at Star

Carr: Noe-Nygaard, 1975), clearly animals that got away the first time. Danish foragers were quite selective, concentrating on animals in their prime (Bay-Petersen, 1978), perhaps because, with the growing importance of plant foods as dietary staples, hunting was becoming increasingly a prestige activity (Mithen, 1987). In the upper Danube valley, two forager bands spent most of the year in the valley or the adjacent Swabian uplands, coming together at the Federsee lake in the summer when the fish were running (Jochim, 1976).

The Iron Gates are a c.100-kilometre-long series of gorges where the River Danube cuts a gap between the Carpathian mountains to the north and the Dinaric Alps to the south. The teeming fish of the Danube here sustained the development of increasingly sedentary communities, with group sizes nearer a hundred or more rather than the 25 suggested for the 'typical' forager band (D. W. Bailey 2000; Bonsall *et al.*, 1997; Borić, 2002, *et al.*, 2004; Radanović 1996). Their only domesticate was the dog. The best known sites are Lepenski Vir, Padina, and Vlasač on the Serbian bank, and Schela Cladovei and Icoana on the Romanian side. The most substantial phases of these settlements are later, but already by the eighth millennium BC people were settling down by the river. They built trapezoidal huts with the floors levelled with a crushed lime mortar, as well as less regular oval structures. There are numerous burials, some bodies (or parts of bodies) being deposited apparently with little formality in and around structures, but others in what seem to be special burial zones around open-air rectangular hearths, the clusters suggesting that these communities were divided into well-defined social groups (Borić and Stefanović, 2004). The men generally seem to have lived 50–60 years, women 30–40 years. The seasonality indicators in the food refuse (bones of deer, cattle, pig, chamois, birds, molluscs, and several species of river fish, especially the migratory sturgeon) indicate multi-seasonal occupations, and the rebuilding evident at the sites (Fig. 9.5), like the reserved burial zones, is clear evidence for certain localities acquiring and retaining special significance for settlement in a manner unique in Mesolithic Europe at this time. Over time there are signs of increasing social differentiation, and of the more ordered segmentation of space within buildings and settlements. A unique find at Lepenski Vir was a series of boulders sculptured as fishes or fish-human hybrids, which have been interpreted as evidence of belief systems characterized by a special totemic relationship between humans and fish, in which humans metamorphosed into fish when they died (Borić, 2005).

Many parts of temperate Europe continued to be inhabited by mobile and (as far as we can tell) less socially differentiated foraging populations during the Atlantic phase. They practised broad-spectrum foraging much as before, though generally with an increasing use of plant foods in response to the greater plant-food diversity of the period, collecting edible roots and tubers

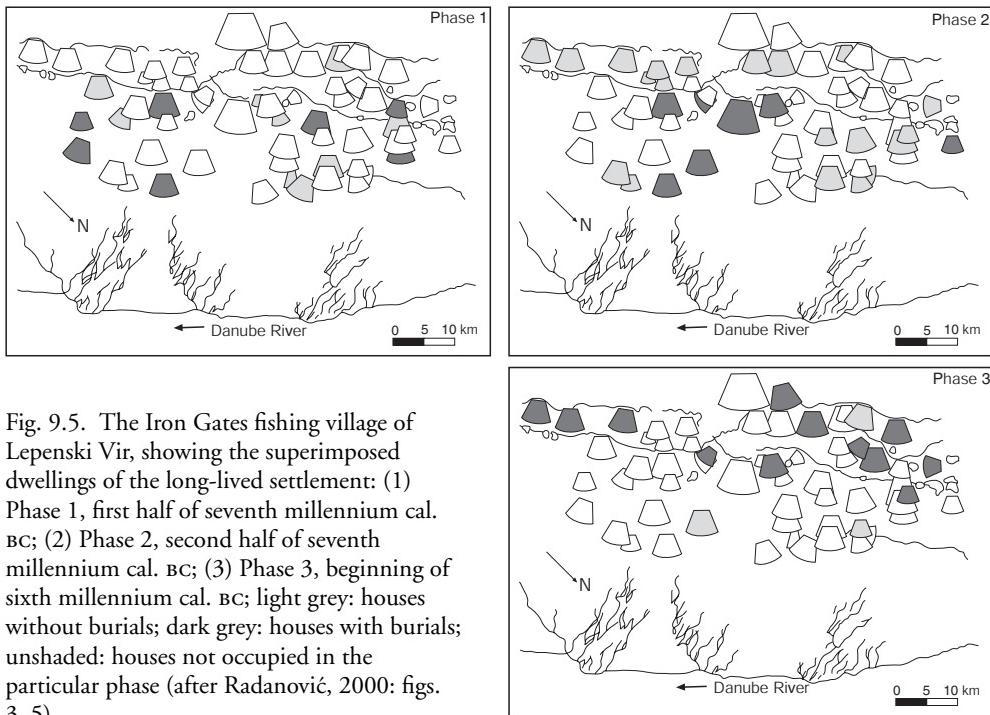


Fig. 9.5. The Iron Gates fishing village of Lepenski Vir, showing the superimposed dwellings of the long-lived settlement: (1) Phase 1, first half of seventh millennium cal. BC; (2) Phase 2, second half of seventh millennium cal. BC; (3) Phase 3, beginning of sixth millennium cal. BC; light grey: houses without burials; dark grey: houses with burials; unshaded: houses not occupied in the particular phase (after Radanović, 2000: figs. 3–5)

in the winter and spring, stems, shoots and young leaves in the early summer, and seeds, nuts, and fruits in the summer and autumn (Parker-Pearson, 2003; D. Perry, 1999; Zvelebil, 1994). Their habitation sites are invariably small seasonal camps, not only in the interior regions of central Europe (Bogucki, 1988; Kozłowski and Kozłowski, 1986), but also in some coastal regions, such as the Rhine-Meuse delta (Louwe-Kooijmans, 1993, 2001) and coastal Scotland (Young, 2000). Morton on the east coast of Scotland, for example, was visited in late winter or early spring for hunting forest game, fishing for species such as cod and sturgeon (presumably taken from skin boats), and collecting shellfish (J. M. Coles, 1971). Staosnaig on the island of Colonsay was an autumn or winter locale for harvesting hazelnuts and tubers of the Lesser Celandine, *Ranunculus ficaria* (Mithen *et al.*, 2001). The tiny island of Oronsay near Colonsay was probably one of a number of places visited through the year by people who spent most of the year on larger neighbouring islands such as Colonsay and Jura or on the mainland (Mellars, 1987; Mithen, 2000; Mithen and Finlayson, 1991). They visited Oronsay for limpet collecting, saithe fishing, and seal killing, the strength of the marine isotope

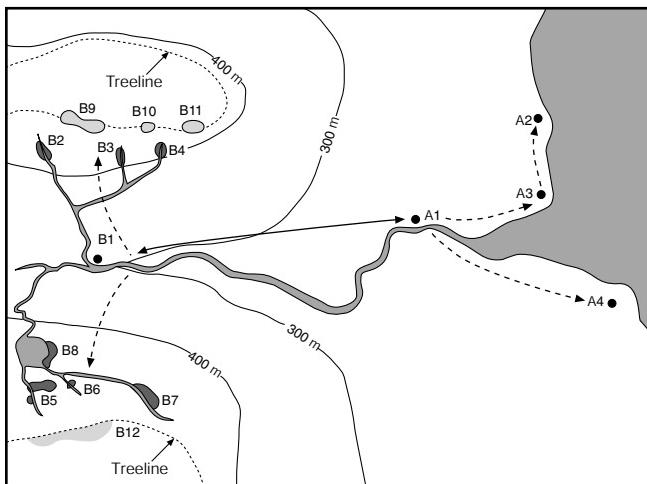


Fig. 9.6. A model of Late Mesolithic resource scheduling and territoriality in eastern northern England: a forager band spends most of the year on the lowlands, using a series of coastal special-purpose camps (A2–A4) to supply their lowland base camp (A1), but moves inland in the autumn to camp in a valley on the edge of the uplands (B1), from which parties move into the hills to hunt red deer in areas they have burnt previously to improve browse within the forest (B2–B8) or at the edge of the treeline (B9–B12) (adapted from I. G. Simmons, 1996: fig. 3)

signatures in their bodies suggesting that marine foods may have dominated their diet throughout the year (M. P. Richards and Mellars, 1998; Schulting and Richards, 2000a). Other groups moved on a seasonal basis between coast and interior (Schulting and Richards, 2002b).

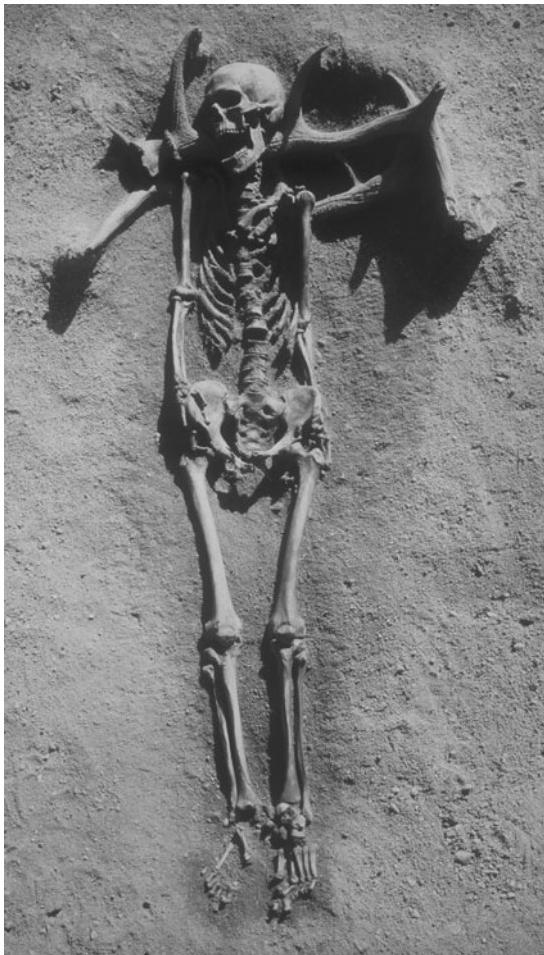
A consistent feature of Late Mesolithic subsistence, as with many other foraging peoples past and present, appears to have been burning vegetation, to make clearings within forest and to open up the forest edge (I. G. Simmons, 1996; Simmons and Innes, 1987; Simmons *et al.*, 1989). The evidence is strongest in British upland regions such as the Pennines, which are commonly thought to have been exploited on a seasonal basis (Fig. 9.6). Though the burns were probably very small scale, firing the woody vegetation would have increased the amount and quality of browse for animals such as red deer, and in many environments would also have improved the range and amount of human plant foods such as nut and fruit trees, seeded plants, and tuberous plants (Mellars, 1976; Zvelebil, 1994).

At the same time, complex foraging societies developed in a number of resource-rich locations along the Atlantic seaboard and around the Baltic Sea (Rowley-Conwy, 1983; Zvelebil, 1996a; Zvelebil *et al.*, 1998). The vis-

ible piles of shellfish at many Ertebølle (Late Mesolithic) sites in southern Scandinavia, including Ertebølle itself, gave rise to the Victorians' notion of lowly Mesolithic 'strandloopers' living a precarious and opportunistic existence. The reality could not be more different. Detailed studies of settlement evidence in southern Scandinavia indicate that the major communities were organized in tightly packed households akin to many later agricultural villages, the carefully structured use of space within each dwelling suggesting that during the day a platform at the back was reserved as female space and the front portion of the dwelling for men, with both sexes then sleeping on the platform at night (Grøn, 2003). Strategies of subsistence specialization were developed, a particular focus being the capture of seasonally aggregating migratory resources such as seals, fish (salmon, eel, trout, and so on), and waterfowl. Special-purpose seasonal camps were used for killing particular resources, such as Ølby Lyng (Denmark) for seals, Aggersund (Denmark) for swans, and Jardinga (Netherlands) for aurochs and red deer (Prummel *et al.*, 2002). Efficient specialized technologies by Ertebølle foragers (and those of the southern Baltic region, generally termed Ellerbek) were developed to cope with the time stresses of this kind of foraging: weirs, dams, nets, traps, fish spears (leisters), harpoons for sea-mammal hunting, and canoes (Andersen, 1986; C. Christensen, 1999). Pointed-based pottery was also used for food storage and preparation. An efficient technology was developed for digging, reaping, and plant processing. At the hub of the networks of specialist camps were the main settlements such as Ertebølle, Dyrholmen, Meilgaard, and Vedbaek, especially at coastal/estuarine locations, which were probably semi-sedentary if not sedentary (Rowley-Conwy, 1981a, 1983).

Perhaps the most striking evidence of the complexity of these people is their cemeteries (Fig. 9.7). Bodies were buried sometimes within settlements, even within houses, but over time special areas were set aside. These cemeteries must have represented important symbolic statements of group territorial ownership, like the decorated wooden landscape markers mentioned earlier. They vary considerably in size: Olenii Ostrov in Karelia and Cabeço da Arruda in Portugal have yielded hundreds of bodies, but most cemeteries have some 20–60 bodies. There was considerable variation in burial, with people buried on their own or in groups, lying full length or crouched, with or without ochre and varying amounts of grave-goods. The latter included flint blades and axes, bone points, necklaces and other body ornaments (commonly of animal teeth, tusk, and so on), and sets of antlers laid carefully over the body. At Skateholm in Scania there were also individual burials of domestic dogs accompanied by grave-goods, presumably a reflection of the value they had given their owners in life and their special status in death (Larsson, 1989a, 1989b, 1993, 2004a). One of the most moving burials at Vedbaek in Denmark was that of a woman

Fig. 9.7. Late Mesolithic burial from Vedbaek, Denmark: a 50-year-old woman laid on red deer antlers (photograph kindly provided by the National Museum of Denmark)



and her newborn child, the latter placed on a swan's wing (Albrethsen and Brinch Petersen, 1976).

In general there are few children or old people of high status in the cemeteries, suggesting that social differentiation was according to age or sex, with status deriving from achievements in life rather than being ascribed by birthright. Both men and women achieved high status, though more frequently males. At a few sites, including Olenii Ostrov, and Hoëdic and Téviec in Brittany, there are also indications of social ranking by birthright marked by differential wealth, and there may have been separate clan groups at Olenii Ostrov. Isotope studies hint at gender-based dietary differences in the Breton cemeteries of Téviec and Hoëdic, with women, especially younger women of

child-bearing age, eating less marine food than the rest of the community, a difference tentatively identified as evidence for exogamous patrilocal marriage patterns (linking higher status families, perhaps), whereby women from inland communities were marrying into these coastal communities (Schulting and Richards, 2000b). Differential limb development between men and women in the Skateholm cemetery (the men being much more robustly developed than the women) is a hint that women gained status other than through physical labour, perhaps by association with high-status men (Constandse-Westerman and Newell, 1989). A few bodies at Olenii Ostrov were accompanied by carved effigies of snakes, elks, and humans suggesting that they may have been shamans, their ritual power passed from generation to generation (O'Shea and Zvelebil, 1984). The placement of rock carvings in the landscape, especially in liminal places such as shorelines, is further evidence of the complex belief systems of these societies (Larsson, 2003/4). Another striking indicator of the changed world these societies represent is the evidence in many cemeteries for violence, such as bones with healed wounds from past encounters, or with the arrowheads that caused death still stuck in them, and occasional hints of cannibalism (Price, 1985).

Large semi-sedentary or sedentary communities structured in households; economic specialization, probably involving a degree of labour differentiation; food storage and 'delayed return' subsistence systems; pottery and quasi-horticultural technologies; craft and food production in some cases at the household level; the use of burials of past generations to mark territorial ownership; social differentiation, including ranking and the differential accumulation of wealth; warfare: clearly, these have all been regarded as the classic signatures of farming societies, not foragers (Chapter 2). Most intriguing of all in this respect are hints at animal management by some Late Mesolithic communities, beyond the palynological evidence for landscape management and food enhancement through controlled burns, and the archaeozoological evidence for the selective nature of pig and red deer hunting. Some wild pigs may have been fed as 'storage on the hoof', and transported to Baltic islands (Zvelebil, 1995, 1996a) reminiscent of the transport of the cuscus to New Ireland by late Pleistocene foragers (Chapter 6, p. 210). A Mesolithic community in the French Alps kept a tamed brown bear, on the evidence of its lower jaw having been bound by a thong from a young age (Chaix *et al.*, 1997). Though there is no convincing evidence for morphologically domestic cattle or pigs in Ertebølle settlements (Rowley-Conwy, 1995, 2004), cumulatively the evidence suggests the existence within some Late Mesolithic foraging communities of resource management behaviours which 'can be seen as a crucial development foreshadowing the change attendant on the introduction

of agro-pastoral farming on the one hand, and providing a viable alternative to it on the other' (Zvelebil, 1996a: 167), evidence that chimes with the other indicators that some of these communities had begun to 'think like farmers' in many other respects.

TRANSITIONS TO FARMING IN SOUTHERN EUROPE

The earliest definite indications of agro-pastoralism in the Mediterranean are from the island of Cyprus, from sites such as Mylouthkia and Shillourokambos dated to the second half of the eighth millennium BC (Peltenburg *et al.*, 2000; Fig. 4.1). These sites have a material culture very similar to that of PPNB villages in South-West Asia, and the same suite of morphologically domestic cereals, legumes, and livestock (including perhaps the first domestic cats—at Shillourokambos a cat was found carefully buried with its owner and other grave-goods: Pennisi, 2004). It would appear that an extended period of 'exploration and the generation of inter-regional and seafaring knowledge' (Peltenburg *et al.*, 2000: 852) by foragers was followed by the purposive colonization of the island by Levantine farmers, a process perhaps facilitated by a growing symbolic significance of islands in expanding mental maps (Erdoğan, 2003). Crete, though, first seems to have been settled c.6800 BC by Early Neolithic farmers (at Knossos), no evidence yet having been found for earlier forager explorations (Broadbank and Strasser, 1991; Hamilakis, 1996).

Mound or *tell* settlements in north-east Greece contemporary with Knossos, such as Nea Nikomedea, Argissa, and Sesklo, have traditionally been interpreted as the villages of agriculturalists who had migrated into the region, in this case from Anatolia, because of their many similarities with Turkish Early Neolithic settlements in terms of tell construction, settlement layout, house architecture, ground and polished stone, bone and antler tools, fine decorated pottery, fired clay figurines, and similar forms of plant and animal husbandry, and in all the above their differences from preceding late Mesolithic settlement in northern Greece (Perlès, 2001; Fig. 9.8). They cultivated wheat (emmer, einkorn, bread wheat), barley (2-row and 6-row), and legumes (lentils, chick peas, bitter vetch), and kept sheep and goats, cattle, pigs, and dogs. Wild fruits and nuts were gathered (such as figs, pears, acorns, grapes, almonds, and pistachio), and hunting was practised on a small scale. The tells are sometimes just 2–3 kilometres apart, and probably had populations numbering from several tens to several hundreds of inhabitants, suggesting that they can indeed be termed villages, the communities organized in households living in small cabins of timber posts and wattle frames

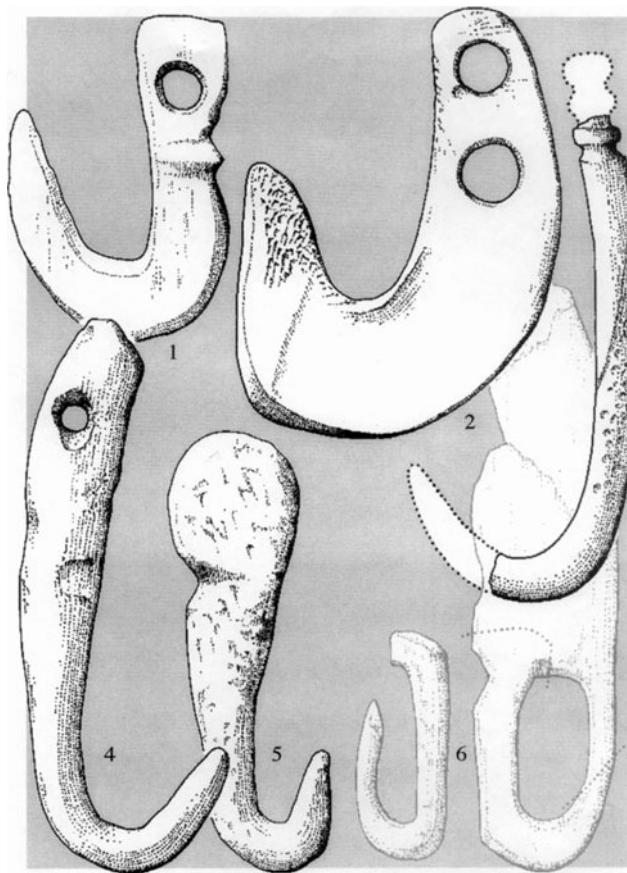
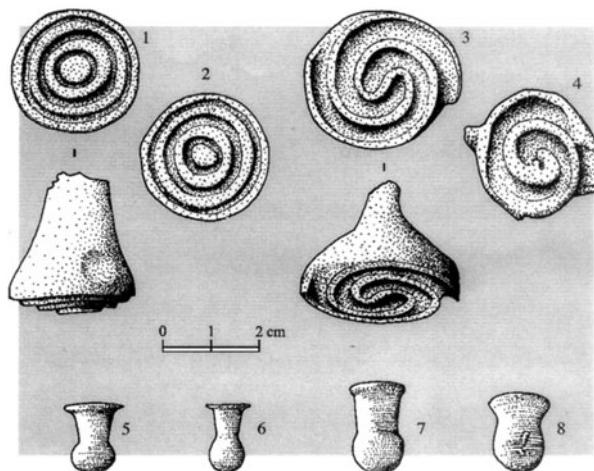


Fig. 9.8. Similarities in the material culture of Early Neolithic tells in Greece and the Levant: (above) bone hooks from (1, 4, 5) Çatalhöyük, Turkey, and (2, 3) Soufli Magoula, Greece, and (6, pre-form of bone hook) Nea Nikomedeia, Greece; (below) clay stamps from (1) Tell Hallula, Syria, (2) Sesklo, Greece, (3) Çatalhöyük, (4) Nea Nikomedeia, and stone earstuds from (5) Haçilar, Turkey, and (6) Soufli Magoula and (7, 8) Sesklo; the scale refers to both illustrations (Perlès, 2001: figs. 4.2 and 4.3; illustrations kindly provided by Catherine Perlès)



plastered with mud, clay, and straw, much like the Balkan example illustrated as Figure 9.11.

The construction of the tells has been explained as a functional response to living in alluvial landscapes prone to flooding (van Andel and Runnels, 1995; van Andel *et al.*, 1994), though the importance of symbolic ties to place is also indicated by the within-community burials, figurines (representations of ancestral figures?), and the building of successive houses in the same place (D. W. Bailey, 2000). The wet and forested landscapes in which they were situated were clearly not well suited to animals of semi-arid open habitats such as sheep and goat, and stock-keeping was probably on a small scale (Halstead, 1989). However, as the numerous clay figurines of domestic animals imply, livestock may well have had considerable significance in other respects, for example as a form of 'social storage' that could be accumulated as a prestige item for consumption in feasts or for trading on the hoof (Halstead, 1987, 2000). This notion chimes reasonably with Perlès's (2001) characterization of these societies as horizontally differentiated in economic roles and social status, with individuals and communities bound together in relations of reciprocal obligation.

The fact that there is hardly any evidence for earlier forager settlement on the alluvial plains of Thessaly has long been taken as evidence that the tell communities must be Neolithic colonists, and many scholars still prefer this interpretation (e.g. Perlès, 2001; Tringham, 2000). However, the evidence for 'fully formed' tell communities from the outset is in fact somewhat uncertain, sites such as Achilleion consisting of small-scale pit complexes in their initial phases, and it is now clear that there were open or flat settlements such as Makriyalos as well as the tells (Pappa and Besios, 1999). Such sites were probably the dominant form of settlement at this time (Bintliff *et al.*, 1999). It is possible, therefore, that the agricultural communities of the tells in fact developed gradually and unevenly, in whole or in part, from the existing forager population of the region, over several generations, rather than arriving 'fully formed' from Turkey (Whittle, 1996: 71).

About the same time that farmers settled at Knossos, domesticated cereals (emmer wheat, and two-row hulled barley) and livestock, including sheep and goat, are found in Franchthi Cave. Yet there is strong evidence for continuity in the lithic industry, and hunting and gathering (for example the collection of pistachio, almond, various legumes, and wild grasses) continued to be practised alongside plant and animal husbandry. Given this evidence, the Franchthi sequence is easier to explain in terms of the existing foraging community developing a commitment to husbandry as a component of their subsistence behaviour, rather than as the sudden displacement of foragers by incoming farmer-foragers. This scenario is typical of foraging-farming

transitions further west in the central and western Mediterranean, though the precise mechanisms are unclear. In the Adriatic, for example, foragers at Sidari on Corfu, at the southern end, started to use pottery and livestock c.6500 BC and after a gap of 300 years Impressed Ware and livestock spread rapidly (within a century) northwards as far as the island of Korčula, some 400 kilometres from Corfu. Impressed Ware and livestock then spread more slowly up the Dalmatian coast and the opposing coast of the Italian peninsula to the head of the Adriatic, as foraging communities began to abandon caves, establish new open-air settlements, and commit to farming (Forenbaher and Miracle, 2005). The presence of obsidian (probably from the island of Lipari off Sicily) at Early Neolithic sites on the Dalmatian side of the Adriatic, as well as the close similarities between the Italian and Dalmatian Impressed Ware assemblages, emphasize the importance of maritime communication systems in this process, though petrological analysis indicates that the pottery was invariably locally made rather than being traded (Spataro, 2002).

Like the tells of Thessaly, the 'ditched villages' of the Tavoliere plain in Puglia in south-east Italy (Fig. 9.9) have long been regarded as the settlements of Neolithic colonists, in this case from the eastern Adriatic (Bradford, 1949; Cassano and Manfredini, 1983; G. D. B. Jones, 1987). In a region lacking convincing evidence for preceding Mesolithic settlement (the plain itself, that is, as there are many coastal caves in southern Italy with Mesolithic habitation evidence), they appeared to represent the sudden appearance of mixed farming a few centuries after the Greek tells, associated with items of material culture such as painted pottery with demonstrable links with the Greek Early Neolithic. However, the earliest Tavoliere sites could equally well be understood alongside other enclosure settlements with Early Neolithic pottery such as Asfaka in north-west Greece and Smilčić in Dalmatia in terms of semi-mobile forager communities developing a commitment to agriculture, a process involving the exploitation of previously unused or little used (but already known) parts of the forager resource zone (Skeates, 2000). Though the enclosures have often been interpreted simply as corralling devices for livestock, they also served to emphasize group identities, territorial ownership, ancestral ties to land, and so on. In some respects this was a new 'place-based' view of the world tied to the ownership of domestic plants and animals, though computer simulation of the territories around Early Neolithic sites in Calabria suggests that the 'wildscape' (woodland and pasture) was just as important as arable in how these communities signified their ties to the land (Robb and van Hove, 2003), a mix of forager and farmer world-views not surprising in these transitional societies.

Many caves in peninsular Italy and Sicily have yielded stratified sequences with evidence for foraging in the earlier Holocene followed from about the



Fig. 9.9. A WW II air photograph of the Passo di Corvo Neolithic settlement on the Tavoliere plain, southern Italy, interpreted as a series of 'hut compounds' enclosed by ditches (original photograph by John Bradford, kindly provided by the late Barri Jones)

early fifth millennium BC by a mix of foraging and farming, sheep and goat herding especially (Skeates and Whitehouse, 1994; Tusa, 1996). These activities were commonly associated with Neolithic pottery and lithic assemblages dominated by traditional foraging technologies, the latter with admixtures of typical Neolithic pieces such as polished axes and sickle blades. Arene Candide on the Mediterranean coast at the present-day Italian–French border was such a 'mixed subsistence' site, dung preserved in the cave showing that sheep and goats were corralled there (Maggi, 1997; Rowley-Conwy, 1997). San Marco near Gubbio is a good example of an open site of this phase, a seasonal encampment used by Early Neolithic mobile forager-farmers (Malone and Stoddart, 1992). They hunted red and roe deer and smaller game such as hare; kept sheep, goats, cattle, and pigs; gathered a wide range of seeded plants, berries, and nuts; and cultivated emmer, einkorn, club wheat, bread wheat, six-row barley, and legumes such as pea and vetch. These small-scale and mobile societies were generally characterized by segmentary tribal

structures, without marked ranking or differentiation in gender roles and ideologies (Chapman, 1988; Robb, 1994; Skeates, 1994; Whitehouse, 1992). There is similar evidence for forager-farmer societies in Dalmatia, northern Italy, southern France, coastal Spain, and Portugal (e.g. Barker *et al.*, 1990; Boschian and Montagnari-Kokelj, 2000; Carvalho, 2002; Forenbaher and Miracle, 2005; Maggi, 1997; Rowley-Conwy, 1997). Though clearly there were significant changes in behaviour in train, the landscape 'footprint' (environmental impact) from their activities was essentially the same as those of their forebears (e.g. Chester and James, 1999; Lowe *et al.*, 1994; Vernet, 1999).

In Thessaly, the agricultural basis of the tells in the Later Neolithic was small-scale but intensive rather than large-scale and extensive (Halstead, 2000; G. Jones, 1987). The system sustained increasing social elaboration and economic complexity, including centralized food storage (Halstead, 1996). Changes in faunal mortality structures indicate the increasing importance of livestock secondary products. The exchange of livestock and foodstuffs within and between households to combat the vagaries of the Mediterranean climate may have been a critical stimulus for the accelerating process of wealth differentiation and social ranking we can observe here by the third millennium BC, the Late Neolithic and Early Bronze Age (Halstead, 1992a, 1992b). The period was characterized by an expansion of herding activity (small-scale transhumance) into the uplands (Halstead, 2000). This was probably the main process behind the first significant (though extremely small-scale) anthropogenic disturbances that have been observed by palynologists and geomorphologists in the Greek uplands (Atherden, 2000). The process may have been facilitated by a trend towards a drier climate at the transition from the Atlantic to Sub-Boreal climatic phases, which would have favoured the development of more open vegetation in the mountains (Bintliff, 1992).

In the central and western Mediterranean the development of a clear commitment to mixed farming by the Late Neolithic (the fourth millennium BC) and Chalcolithic (the third millennium BC) was associated with a marked acceleration in social complexity. In Italy there were complex alliance networks and increasingly competitive elite behaviours marked by defended settlements, small-scale warfare, and warrior ideologies (Skeates, 1997). For these societies mountains acquired new significance as the source of high-value trade commodities such as copper (Maggi and Vignolo, 1987) and jasper (Maggi *et al.*, 1995), but the expansion of upland settlement also reflected, as in Greece, the increasing importance of seasonal transhumant pastoralism: the ceramic repertoire includes spindle whorls and perforated strainer sherds that are presumed to have been used in cheese-making, and the faunal samples commonly indicate a shift in the emphasis of animal husbandry towards

secondary products as well as meat (Barker, 1995; Cruise, 1991; Rowley-Conwy, 1997).

Parallel trends in social complexity can be observed at this time in the western Mediterranean, notably in the Millaran Chalcolithic cultures of Almeria, the most arid part of south-east Spain (R. W. Chapman, 1990; Monks, 1997). In the Vera valley, for example, a distinct settlement hierarchy had developed by the third millennium BC, with substantial fortified hilltop sites at the apex of the system. Excavations at Gatas and Fuente Alamo indicate that these communities were sustained by agricultural systems that combined localized horticulture and extensive farming on the hill-slopes beyond, including the cultivation of the vine and fig and less certainly the olive (Castro *et al.*, 2000; Ruiz *et al.*, 1992). The wild olive is native to Spain and the fruits were eaten by Neolithic communities (Gilman and Thorne, 1985). On the evidence of the frequency and dimensions of olive charcoal at Los Millares it has been argued that Millaran farmers may have cultivated the olive, but Mediterranean polyculture (the cultivation of cereals, olives, and vines) was probably not practised here till the second millennium BC at the earliest (Ruiz *et al.*, 1992). These societies may, however, have started the practice of managing woodlands (*dehesas*) in order to promote animal husbandry, probably by a combination of pruning trees, grazing the understorey vegetation with sheep and goats, pigs and cattle, and manuring the cleared ground (Stevenson and Harrison, 1992).

By the third millennium BC, though palaeoenvironmental indicators emphasize the still-tiny scale of the landscape impacts of arable and pastoral activity compared with later periods, Mediterranean farming included many of the components that have characterized Mediterranean farming to the modern era. These included: sheep- and goat-dominated pastoralism, some of it probably transhumant; ploughing with the ox-drawn ard; the use of donkeys for riding and as pack animals; the cultivation of tree crops as well as cereals and legumes; systems of forest management; and perhaps terracing.

TRANSITIONS TO FARMING IN THE BALKANS AND THE MIDDLE DANUBE BASIN

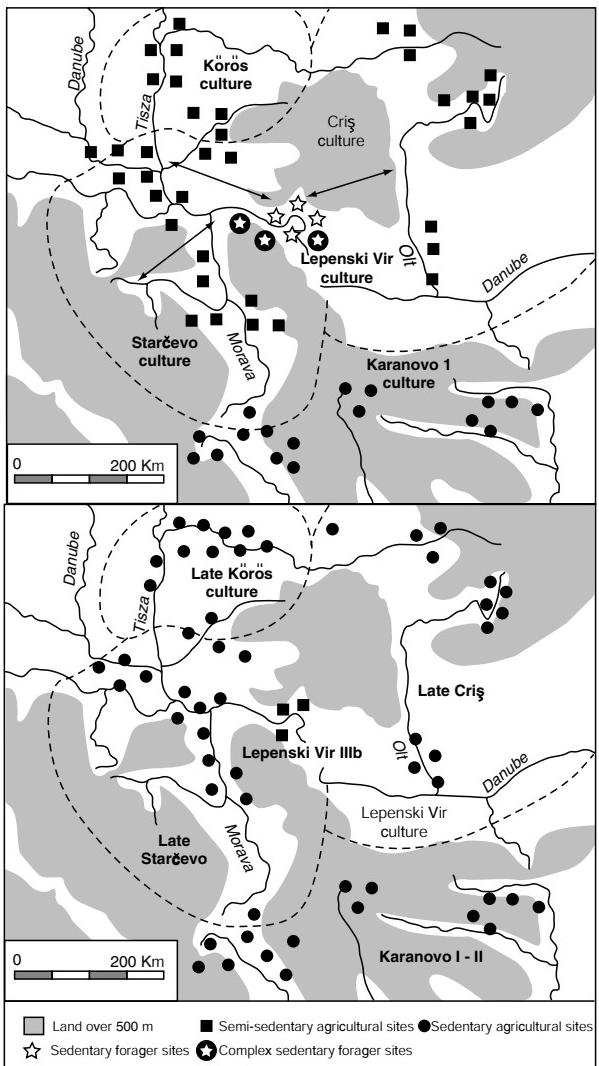
The extent to which the natural distributions of the wild forms of the Eurasian domesticates (wheat, barley, legumes, sheep, goat, cattle, pig, dog) may have extended into temperate Europe is unclear. There were certainly wild cattle and pigs throughout Europe, and earlier Holocene foragers clearly had domestic dogs. There is no convincing evidence for sheep and goats being in temperate Europe prior to their appearance as domesticated species on

Neolithic sites, though the case has sometimes been argued for the Balkans. The natural distribution of some of the wild cereals and legumes probably did extend from the Mediterranean into the southern Balkans, though probably not emmer, which was generally the most important crop grown by Early Neolithic farmers or farmer-foragers in temperate Europe. Hence there seems little doubt that some of the cereals and legumes, and certainly sheep and goats, must have been introduced into the temperate regions of Europe. This fact has been the cornerstone of the theory that agriculture must have been introduced into the Balkans and temperate Europe by Early Neolithic colonists from the south or south-east. When this theory was first put forward by Gordon Childe and contemporary prehistorians, of course, large swathes of Europe appeared to be more or less empty of Mesolithic settlement, which we now know was clearly not the case.

Tell villages were established in the southern Balkans a few centuries after their appearance in Thessaly, c.6600 BC (Fig. 9.10). Distinctive styles of pottery and other aspects of material culture, all with recognizable links to those of the Greek tells, have been used to define regional groupings, in particular Karanovo in Bulgaria and Starčevo in southern Serbia (D. W. Bailey, 2000; Tringham, 2000). The communities were organized into households (Fig. 9.11), with little evidence of significant social differentiation between them, though fine painted pottery implies the presence of specialist craft-workers operating at the supra-household level. Burials in and around the houses (rather than in communal cemeteries) suggest the importance of links between these households and their ancestors. Sedentism is assumed, though in some cases possibly wrongly (D. W. Bailey, 1996, 1997). The agricultural base of the Balkan tells was very similar to that of the Greek tells, the plant residues suggesting well-founded husbandry systems that may have included simple crop rotations to maintain soil fertility (Dennell, 1978; Dennell and Webley, 1975). The scale of this activity, though, should not be exaggerated: the impact made by these farmers on their landscape in terms of forest clearance was just as small-scale as that of the preceding foragers (Willis and Bennett, 1994).

By c.6500 BC there is evidence for mixed farming in the Morava valley of northern Serbia at sites such as Divostin and Grivać, but forms of habitation were more dispersed, dwellings were rudimentary (pit and post-hole structures), farming was combined with foraging, and many settlements were seasonal as a result. In the watery landscapes of the middle Danube basin, the balance was even more towards foraging. People in the Tisza valley and its tributaries such as the Körös river (the Criş river in Romania) lived predominantly by fishing (many sites have large dumps of pike and catfish bones and even scales, together with bone leisters, net weights, and so on), collecting shellfish,

Fig. 9.10. Forager-farmer interactions and transformations in the Balkans and middle Danube basin: (above) the Early Neolithic, 6500–5700 bc: tell farming communities in the southern Balkans, complex sedentary foraging societies to their north in the Iron Gates, and semi-sedentary forager-farmer communities in the Morava and Tisza river systems; (below) the Middle Neolithic, 5700–5300 bc: sedentary farming communities in the southern Balkans and the Morava and Tisza river systems, and semi-sedentary forager-farmer communities at the Iron Gates (after Tringham, 2000: figs. 2.7b and 2.8b)



and hunting game, turtles, and water birds, though they also practised farming on a small scale. They had a much simpler material culture than the Early Neolithic farmers to the south, and were highly mobile, growing spring-sown crops such as millet on the river levees and moving to the drier interfluves with their livestock when the rivers were in flood (J. C. Chapman, 2003; Kosse, 1979). Burning episodes registered in Hungarian pollen diagrams from c.7000 BC are thought to reflect these pastoral activities (Willis, 1997). At the

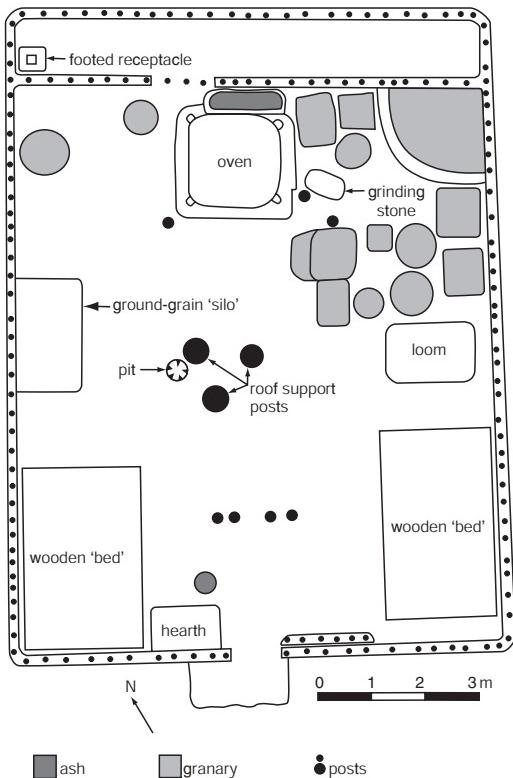
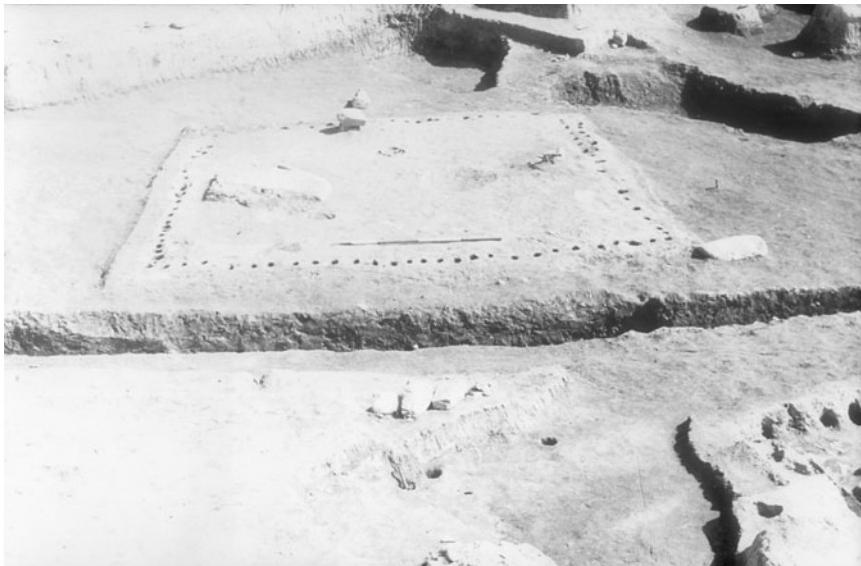


Fig. 9.11. Balkan tell dwellings: (*left*) plan of an Early Neolithic house at Slatina, Bulgaria (after D. W. Bailey, 2000: fig. 2.4); and (*below*) an Early Neolithic house at Chevdar, Bulgaria, with a plaster/post wall marked by post-holes, an oven or hearth on the left, and a single entrance to the right (photograph kindly provided by Robin Dennell)



interface between the farmer and farmer-forager worlds of this region were the sedentary and complex fishing communities of the Iron Gates (Borić, 2002, *et al.*, 2004).

The traditional interpretation of this archaeology has been that agricultural colonists from Greece moved into the southern Balkans taking with them their system of Mediterranean farming, but their daughter communities then had to mix foraging with farming, and adapt their farming systems, as they moved northwards into wetter landscapes and cooler and more temperate environments. Other scholars have explained the Körös sites as local foragers who adopted farming on a small scale from contact with the farmers to the south. The Iron Gates fishing villages have been variously characterized as Mesolithic foragers resisting the ‘wave of advance’ of incoming farmers at one extreme, and centres of indigenous Mesolithic domestication at the other (from the evidence of domestic plants and animals in some levels at Lepenski Vir, though the chronology is much debated). The burials suggest more defined social groupings (extended households, probably) at Lepenski Vir than in the Mesolithic phases of sites like Vlasač, and there are also alterations in burial practice such as in the treatment of infants, but such changes appear to be an extension of earlier social structures and funerary practice rather than a transformation (Borić and Stefanović, 2004). What is clear is that these various communities, all of whom can be categorized as Early Neolithic in terms of their pottery and related material culture, differed enormously in their degrees of sedentism, subsistence behaviour, diet, community organization, and ties to the land. At the same time, on the evidence of sherds of the various regional pottery styles turning up outside their core areas of manufacture and use (e.g. Garasanin and Radovanović, 2001; Radanović, 2000), they were certainly in contact with one another.

The sixth and first half of the fifth millennia BC, the Middle and Late Neolithic, witnessed a developing commitment to agriculture, with infilling in the main settled areas and expansion beyond (Fig. 9.10). The tell communities continued and often expanded in size, and tells were also established in the Morava valley, the best known being Vinča on the Danube outside Belgrade. Mobility was still important for many societies, but foraging now waned in importance. The settlements of the middle Danube and its tributaries were more substantial than hitherto, with multi-roomed houses. We can also discern at some sites stock-keeping systems geared as much to the products of the live animal as to meat, and there is some evidence for an intensification in cereal production. The latter possibly involved the use of simple ploughing devices pulled by cattle: there are cattle phalanges and metacarpals with marked splaying, which can result from the pressure of pulling; a pierced piece of antler may be a primitive ard (Barker, 1985: 100–2);

and there is circumstantial evidence for hoe-cultivated gardens being replaced by ploughed fields at Selevač (Tringham and Krstić, 1990). The first signs in the palynological record of land use having a widespread impact on vegetation in the region date from this period (Willis and Bennett, 1994). The period was also characterized by the increasing production and exchange of prestige goods and the beginnings of inter-house competition (D. W. Bailey, 1997, 2000). Cult paraphernalia, common at most sites and sometimes in clusters suggesting shrines or special cultic buildings, are generally interpreted in terms of the importance of fertility rites. These developments in economic and social complexity presaged the appearance of the markedly ranked societies of the Balkan Chalcolithic in the later fifth and fourth millennia BC.

THE LINEARBANDKERAMIK IN CENTRAL EUROPE

The agricultural frontier appears to have stayed within the middle Danube basin and the encircling ring of the Carpathian mountains for a thousand years. There was then (c.5500 BC) an extraordinary expansion in farming systems, extraordinary in both its scale and rapidity, represented by the appearance of sites with Early Neolithic *Linearbandkeramik* (LBK) pottery. (The term LBK derives from the linear incised designs with which the pottery was decorated.) The distribution extends from northern Hungary (the northern part of the middle Danube basin) north to the Baltic, and from the Paris basin on the west to the Bug and Dniester rivers east of the Carpathians on the east (Fig. 9.12). There are thousands of sites, their distribution coinciding generally with the distribution of loess soils.

The first excavations of LBK sites in the 1930s such as Köln-Lindenthal found large pits filled with domestic rubbish that for a time were thought to be the LBK dwellings (Buttler and Haberey, 1936), but large-scale excavations in the 1950s and 1960s at sites such as Geleen, Elsloo, and Sittard (Modderman, 1958–9) in the southern Netherlands and Bylany (Soudsky, 1962) in what is now the Czech Republic demonstrated that the major settlements were thatched structures with massive timber posts and wattle and daub walls (Fig. 9.13). The main buildings were rectangular longhouses mostly 15–30 metres long and 6–7 metres wide, which ceramic studies indicate are likely to have belonged to extended families organized as individual households. A tripartite division of the space is often apparent in the arrangement of the timber posts, leading to theories that people probably lived in the centre, kept their animals at one end, and stored food and equipment at the other. Some longhouses appear to have had one end reinforced, which has been interpreted in terms of a second storey for storage or sleeping. There were

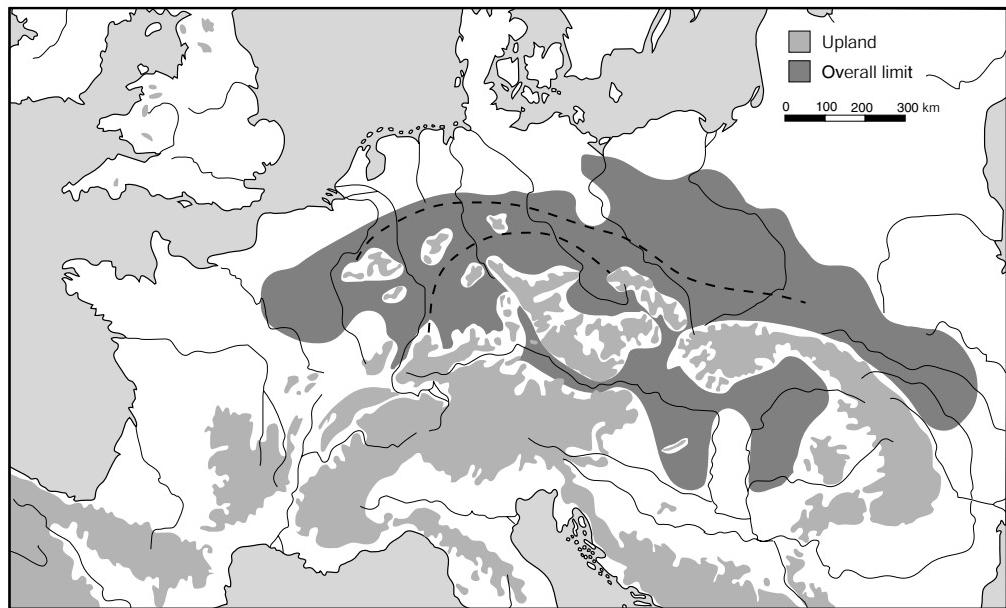


Fig. 9.12. The distribution of primary LBK (*Linearbandkeramik*) settlement in Europe; the lower dashed line marks the limits of the earliest LBK pottery, the upper dashed line the limits of the main category of early LBK pottery, and the shading marks the overall limit of LBK distribution (after Whittle, 1994: 155)

also smaller buildings or huts, and sometimes stock corrals. The pits at the LBK sites were where the clay for the hut walls had been quarried, though they were also used as working places.

LBK settlements vary considerably in size, suggesting a mixture of farms, hamlets, and small villages, but in the latter case they were more a collection of house units on the same north-west–south-east orientation rather than a planned agglomeration of dwellings connected by streets (Lüning, 1988). The settlements were accompanied by formalized cemeteries of greatly varying size, from tens to hundreds of graves. People were both cremated and buried, in the latter case commonly laid on their left side. Objects such as pots, stone, and flint artefacts were placed beside the body. Females were generally buried with pots and small tools, and males with stone adzes and arrowheads, the greater quantities of material with older people suggesting that LBK societies were characterized by clearly demarcated differences in age as well as gender.

LBK people practised husbandry systems that were well adapted to the generally damp and heavily forested landscapes they inhabited at this time in

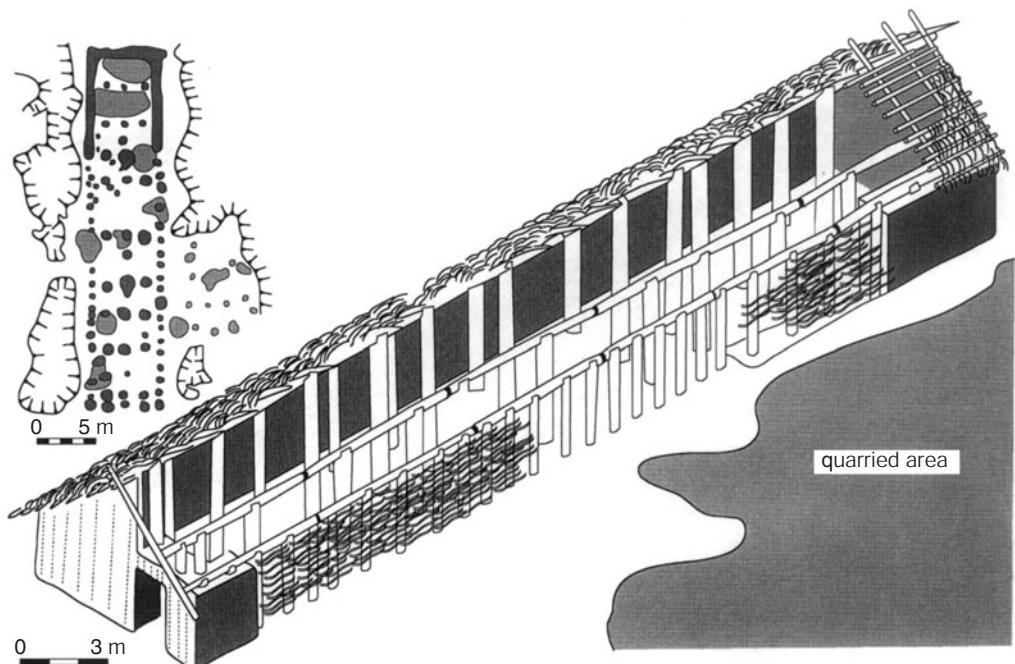


Fig. 9.13. Plan of an LBK house and its surrounding pits, and a reconstruction of an LBK longhouse (after Tringham, 1971: fig. 20)

the late Atlantic. Their production technology included grindstones, sickles, and narrow 'shoe last' adzes that may have been hafted for use as hoes. They grew a range of cereals, especially emmer and barley, but also einkorn, bread wheat, and spelt, as well as legumes such as vetch, pea, and bean, and other crops such as flax and poppy. There is a recurring set of weeds of cultivation with the cultivated plants, but little evidence at most sites for a reliance on wild plant foods for human consumption. There is also a certain amount of evidence for hunting and fishing, but the faunal residues are generally dominated by the bones of domestic cattle, pigs, and sheep, with cattle invariably most frequent. The occurrence of ceramic sieves, presumably for cheese-making (Bogucki, 1984), and possible evidence in the faunal material for cattle castration, suggest that the principles of cattle husbandry were well developed. It is also possible that animal blood was drunk.

In noting the correlation of LBK sites with loess soils, Childe first suggested that the drier soils of the loess would have offered an open corridor facilitating the fast movement of Neolithic farmer-colonists through the forest. It was

then proposed that LBK farmers were able to colonize central Europe rapidly because they practised swidden farming: ‘the best known exponents of the extensive, shifting agriculture of Neolithic times were the Danubian peasants who colonized the loess of central Europe ... clearing small patches of forest, taking a few easy crops, and passing on to fresh ground’ (J. G. D. Clark, 1952: 95–6). Yet many LBK sites have clear evidence for a history of repeated occupations, with successive rebuildings at the same location. In this light Soudsky (1962) suggested that LBK farmers practised a cyclic form of land use, staying in the same general part of the landscape but moving the fields and settlements, returning to a location such as Bylany every generation. The swidden model itself was then effectively critiqued by Rowley-Conwy (1981b), who pointed out that swiddening is mainly used in tropical regions with entirely different soils and climatic regimes from Europe, and that there would have been no need to abandon deep and fertile loess soils every few years to restore their fertility—yields could easily have been maintained with a modicum of crop rotation and manuring. The suites of wild plants at some LBK sites in the Netherlands in fact suggest permanent fields surrounded by hedges, at least in the later stages of the LBK. Archaeobotanical studies also suggest intensive garden cultivation, using predominantly autumn-sown crops (Bogaard, 2004). Such a system implies a substantial commitment of time and labour, as well as a degree of integration between crop husbandry and stock-keeping, such as feeding stock on stubble and fallow, and using them to manure arable land.

Detailed surveys of LBK settlement, for example in southern Poland (Kruk, 1980), the Aisne valley in France (Ilett *et al.*, 1982), and from a major programme of rescue excavation in the path of lignite mining on the Aldenhovener Plateau in north-west Germany (Lüning and Stehli, 1994), have demonstrated that LBK sites usually occur in distinct ‘islands’ or enclaves of settlement rather than being uniformly distributed across the landscape (Fig. 9.14). The settlement enclaves are especially along the smaller tributaries of major rivers. It seems likely that farmers grew their crops in small fields around the settlements, and moved their stock seasonally between the wetter alluvial soils of the river valleys and the drier loess plateaus behind the settlements. In fact, there is much evidence to suggest that many early LBK farmers were seasonally mobile, returning successively to fixed locations: Whittle (1996: 357) termed this ‘tethered mobility’. Wooden-framed wells have been found at several sites, for example, suggesting that reliable watering points for the stock were important. On the sands and clays fringing the loess in northern Germany and Poland, today a landscape of pine forests, heaths, and lakes, LBK sites such as Brześć Kujawski lack evidence for substantial structures, consisting instead of structural evidence more akin to Körös sites,

and producing similar evidence for a mix of foraging and small-scale farming. Early arguments for long-distance patterns of pastoralism between these sites and the loess (Bogucki, 1988) are now discounted, but the evidence still suggests a pattern of small-scale mobility and seasonal movement (Bogucki, 2000).

The exiguous evidence for pre-LBK foraging communities on the loess and the sudden appearance of the LBK farming communities have for long been regarded as the reasons why the phenomenon can most economically be explained in terms of a Neolithic colonization movement coming out of the Balkan Early Neolithic (Bogucki, 2000). The demographic case for such a migration, though (i.e. population stress on Balkan settlements encouraging daughter communities to bud off and head north) has never been satisfactorily made, nor the reasons for the marked differences between the settlement forms, material culture, and subsistence practices of the Balkan Early Neolithic (itself enormously variable, as noted earlier) and those of the supposed daughter LBK communities in central Europe. The evidence of a rapid explosion of LBK culture, rather than a steady expansion outwards from the Balkans, and for discontinuous settlement enclaves, fits poorly with the 'wave of advance' model of Neolithic colonization. Some scholars have proposed instead a process of 'leap-frog colonization': deliberate colonizing movements of farming populations, often over considerable distances, to specific areas with favourable conditions, these locations in turn acting as springboards for further local expansions (Lüning and Stehli, 1994).

However, there is now increasing and widespread evidence for a mobile population of Late Mesolithic foragers making seasonal use of the loess immediately prior to the appearance of the LBK sites, which needs to be brought into any scenario (Jochim, 2000). The 'taskscapes' (Ingold, 1986) of habitual places and pathways inhabited by LBK people may not have been so different from the rhythms of life and mental maps of the preceding forager populations, very different from the discrete and demarcated territories of later agricultural societies. There are indications of a greater mix of foraging and farming in the earliest LBK sites and of marked similarities between their lithic assemblages and those of pre-LBK forager sites. The palynological signatures of human presence in the landscapes of southern Germany and Switzerland in the Mesolithic and Early Neolithic periods are also fundamentally the same, as in the Balkans (Jochim, 2000: 191).

A process of acculturation, whereby the indigenous population of Mesolithic foragers adopted varying combinations of 'Neolithic' attributes from trading contacts with neighbouring populations, has been suggested to account for LBK sites immediately north of the Körös distribution (Otte and Noiret, 2001) and in south-western Germany and France. In the

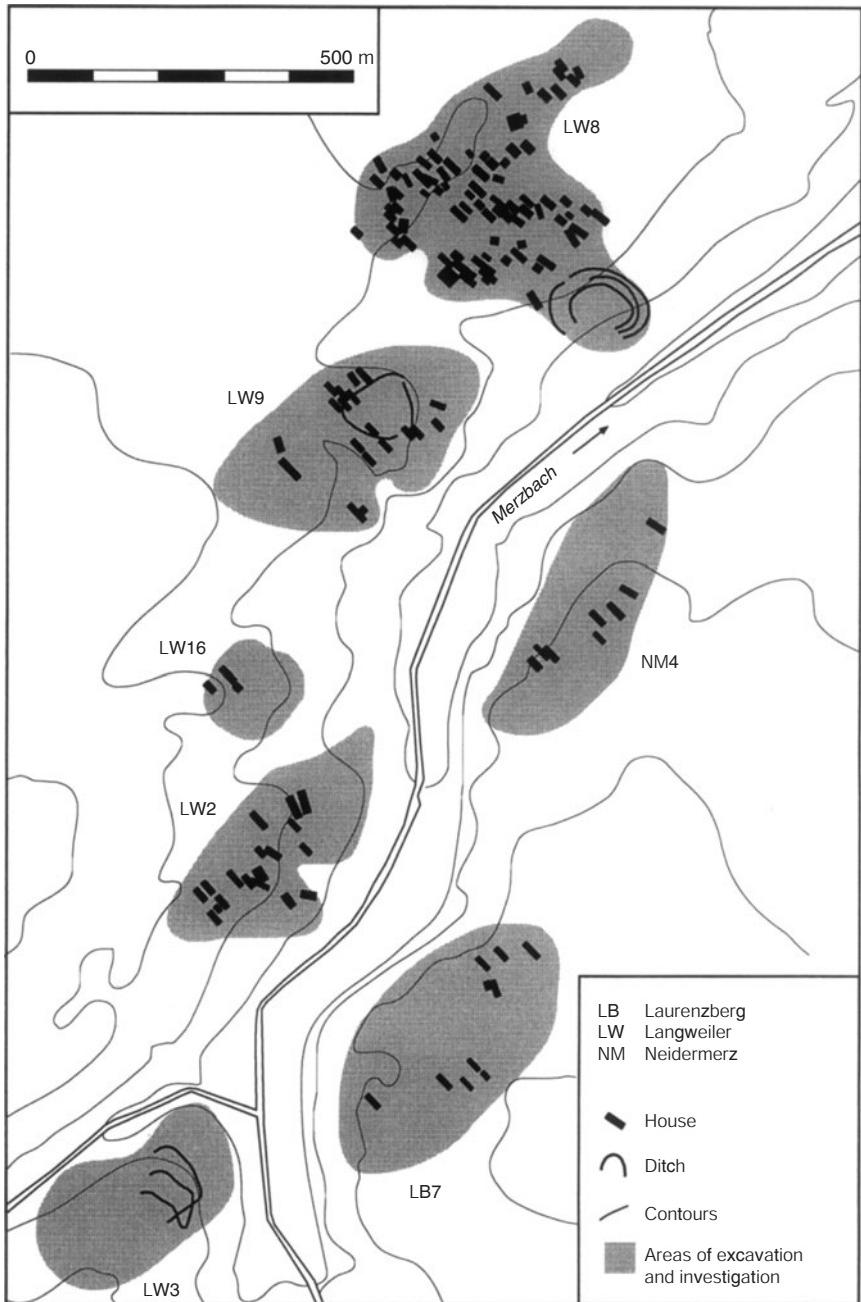


Fig. 9.14. The clustered distribution of LBK sites in the Merzbach valley, north-west Germany; Langweiler 8 (LW8), with its ditched enclosure as well as buildings, may have been the principal focus of this cluster; at any one phase there were considerably fewer dwellings in use (after Whittle, 1994: 160)

latter regions, there is convincing evidence that Mesolithic foragers first developed a form of pottery (named after the site of La Hoguette) and acquired domestic sheep from their contacts with the forager-farmers of Mediterranean France to their south, and then acquired LBK pottery and cattle from the people to their east (Jochim, 2000). Foragers and farmers demonstrably coexisted for several centuries in the upper Rhône valley (Perrin, 2003), and strontium isotope studies of skeletons from LBK sites in south-west Germany indicate a high incidence of non-local females, perhaps marriage partners from neighbouring foraging communities (Bentley *et al.*, 2003). Most convincingly of all, DNA extracted from a number of LBK skeletons from Germany, Austria, and Hungary indicates that most LBK people were genetically identical to the preceding Mesolithic/Palaeolithic population of central Europe, rather than being incomers (Haak *et al.*, 2005).

'The adoption of longhouse architecture and domesticated resources ... enhanced rather than altered existing social values of cooperation and sharing, and extended the possibilities for aggregation and integration into larger social units. This would be one way to explain the cultural unity of the LBK culture. The major shift was to longhouse life, at first in rather small groups, and the shift in resources may only have been an obvious, economical subsistence adjustment, an extension of existing patterns of delayed-return practices' (Whittle, 1996: 153). At the same time, however, given that the main period of sowing (September and October) was also the season for collecting important storable calorie-rich plant foods such as acorns, hazel nuts, and wild apples, and was also when ungulates were in prime condition, it is understandable that farming rapidly displaced foraging amongst LBK communities rather than being practised on a small scale alongside it for a lengthy period (Bogaard, 2004: 162).

Signs of violence in LBK society are comparatively rare, the striking exception being a late LBK mass grave of about 35 men, women, and children at Talheim in Germany (Wahl and König, 1987). Many of the skulls bear the fatal impact of LBK shoe-last celts, so it is difficult to argue for some kind of ambush by hostile foragers! It is also difficult to envisage land hunger as a significant pressure on LBK communities. Talheim could be some kind of ritual kill or punishment, though the age and gender mix of those killed looks much more like a straight massacre. It is noteworthy that at several sites in the northern and north-western margins of the LBK distribution, there are indications of ditch and palisade earthworks (Fig. 9.14), especially at late LBK sites. Some ditches may have enclosed ritual spaces, but the fact that many link up with natural barriers such as lakes and streams suggests that others had a primarily defensive purpose, a point to which I return later.

In the fifth millennium BC, LBK culture was replaced by a series of distinctive regional cultural groupings such as the *Stichbandkeramik* (SBK) culture in (loosely) western Germany and the Lengyel culture in eastern Germany, Poland, and the Czech Republic. Longhouse life continued in greater part, but embedded in an increasingly elaborate ceremonial life represented especially by ceremonial ditched and palisaded enclosures and elaborate burial monuments, features similar to those of the Neolithic cultures that were by then emerging on the periphery of the LBK region.

TRANSITIONS TO FARMING IN BALTIC AND ATLANTIC EUROPE

In many parts of Baltic and Atlantic Europe, the agricultural frontier marked by the limits of the LBK distribution was stable for almost 1,000 years. There was then, c.4500 BC, another dramatically rapid expansion marked by the appearance and first use of domesticates all around the periphery: from the alpine region and western France along the Atlantic coasts and islands (including Britain) to southern Scandinavia and the southern Baltic region and eastwards to the Dnieper and Donetz rivers and the Ukraine. Throughout north-west Europe, cereal pollen consistently appears in pollen diagrams for the first time within two or three centuries around the middle of the fifth millennium BC (Innes *et al.*, 2003). The expansion coincided more or less with the transition from the Atlantic to Sub-Boreal climate, marked in temperate Europe by more continental conditions, with colder winters and warmer summers (Bonsall *et al.*, 2002), so presumably reflects (quite apart from the social contexts of their use) the fact that cereals were now well adapted to the altered patterns of temperature and precipitation.

The case for acculturation as the dominant process in the transition to farming in Europe has been advanced most strongly for southern Scandinavia and the Baltic region (Zvelebil, 1996b; Zvelebil and Lillie, 2000; Zvelebil and Rowley-Conwy, 1984; Zvelebil *et al.*, 1998). The process was envisaged by Zvelebil and Rowley-Conwy (1984) in three stages: an initial ‘availability’ phase when the numerous, sedentary or semi-sedentary, and socially complex foragers of this region first came into contact with LBK farmers to the south and occasionally acquired components of the Neolithic package from them through trade; a ‘substitution’ phase, as they began to acquire and use domestic animals and plants more systematically, with greater impact on their lives; and a final ‘consolidation’ phase when they committed to becoming farmers. In the period of initial contact, the northern foragers acquired components of the Neolithic package probably as objects and activities

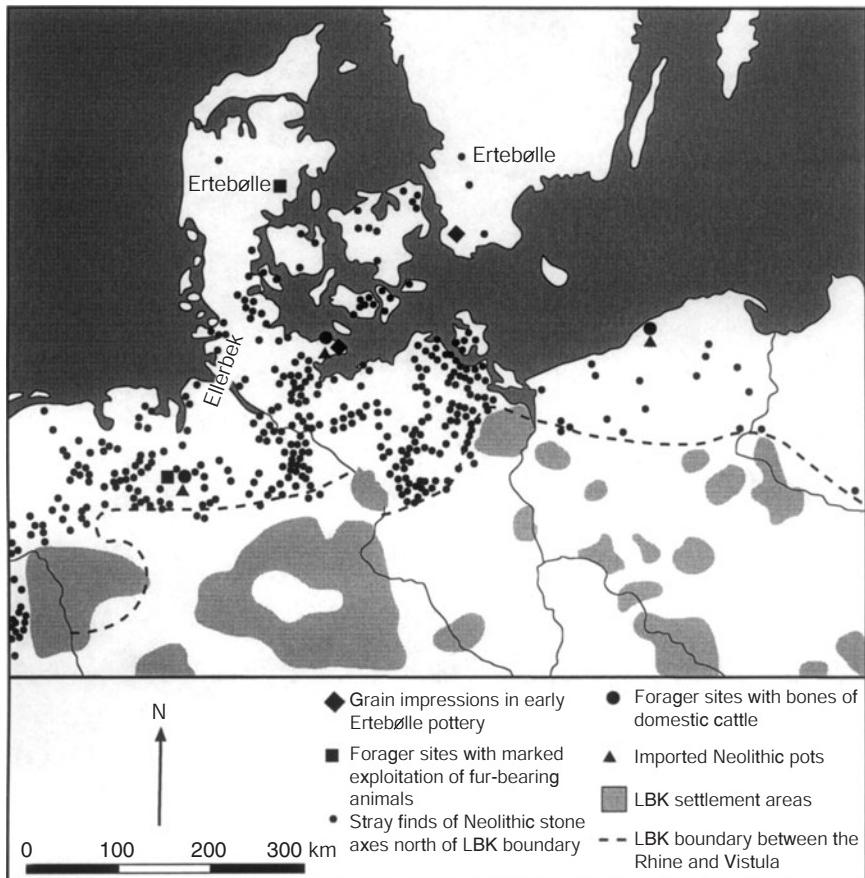


Fig. 9.15. Evidence for forager–farmer contacts on the north European plain and in southern Scandinavia in the fourth millennium BC (after Zvelebil, 1996b: fig. 18.6)

associated with status differentiation rather than subsistence. The evidence consists of occasional finds of LBK pottery, shoe-last celts, and domesticates on Ellerbek/Ertebølle sites (Fig. 9.15). The earliest cereals reliably dated are at Løddesborg in south-west Sweden *c.*4200–4000 BC, on the island of Bjørnholm in the central Limfjord of northern Jutland (Denmark) *c.*3775 BC, and Mossby near Ystad in Scania (southern Sweden) *c.*3700 BC (Price, 2000). A domestic cow from Øgarde on Zealand (Denmark) has been dated to *c.*3850 BC.

The population of southern Scandinavia, though, continued to rely on foraging at this time and remained culturally and economically independent.

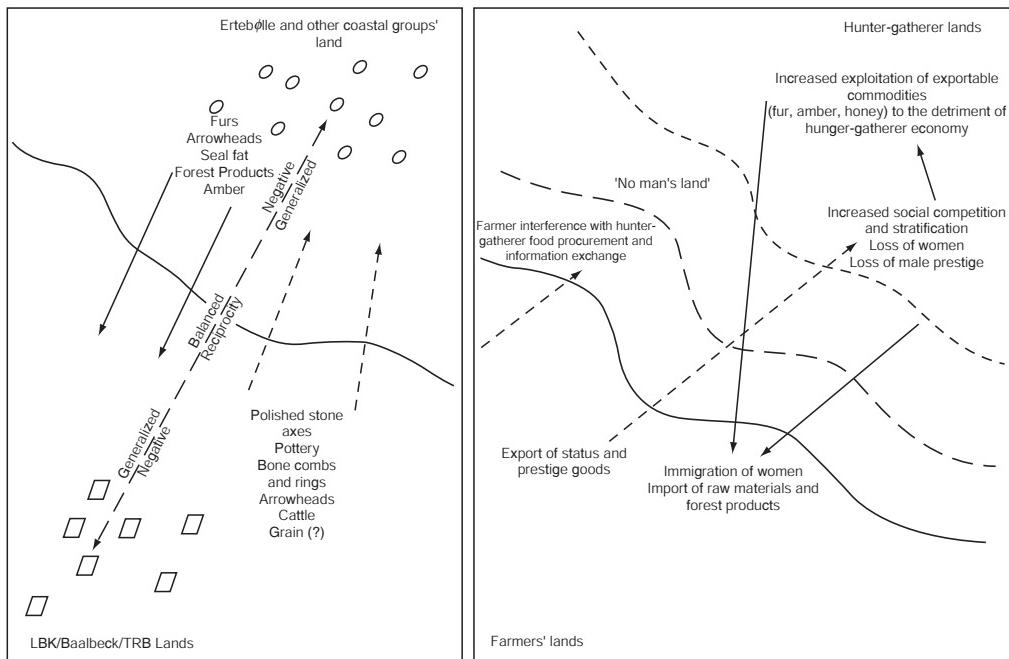


Fig. 9.16. A model of changing relations between foragers and farmers in the Atlantic and Baltic regions: (left) cooperative; (right) competitive (after Zvelebil, 1996b: figs 18.5 and 18.8)

Forager–farmer relations through the second half of the fifth millennium BC and beginning of the fourth millennium BC were probably characterized for the most part by cooperation and ‘balanced reciprocity’, with foragers and farmers exchanging information, foodstuffs, marriage partners, raw materials, and exotic (to the other group) items as prestige goods: items from the foragers’ world such as furs, seal fat, and amber, in exchange for components of the ‘Neolithic package’ such as pottery, polished stone axes, cattle, and grain (Zvelebil, 1996a; Fig. 9.16, left). Feral livestock might also have been involved (Bogucki, 1995), and perhaps labour—many foragers today provide labour for neighbouring agricultural and/or pastoral communities.

In time, though, relations on either side of the farming–foraging frontier seem to have become increasingly competitive, especially as the farming populations grew in number (Fig. 9.16, right). There is evidence of inter-group violence, and several LBK sites in the ‘frontier zone’ had defences built. Earthen long barrows for elite burials, like those of the farming communities to the south, also began to be constructed, for example at Bjørnholm. Perhaps farmers encroached directly on foragers’ territories to obtain raw materials

and forest foods, and land for farming (Zvelebil, 1996b). The increasing importance of acquiring forest products for trade may also have disrupted the traditional foraging balance. For whatever reason(s), the perceived benefits of foraging declined and those of farming increased. The result was that, in about the middle of the fourth millennium BC, the foraging populations of the Atlantic seaboard, southern Scandinavia, and the Baltic region began to practise agro-pastoral farming much more systematically, though still as part of a mixed foraging-farming economy. Isotope studies indicate that there was a quite sudden switch from marine to terrestrial foods (Richards *et al.*, 2003b).

These forager-farmers made Early Neolithic pottery termed Funnel-necked Beakers (*Trichterbeckerkultur*, or TRB) akin to the ceramic styles being developed amongst the farmers of the north European plain. Some sites demonstrate a mix of farming and foraging, but there were also special-purpose camps for particular foraging activities. The husbandry system included the cultivation not only of einkorn, emmer, naked and hulled barley and legumes, but even grapes (Andersen and Johansen, 1992; Price, 2000), along with domestic cattle, and pigs, and, on a very small scale, sheep (as well as dogs, of course). Interestingly, the shift to a greater involvement with agriculture was marked by greatly increased mobility (presumably part of the reason for the shift to more land-based food in the diet) and fragmentation in the old order. Many Ertebølle sites continued to be used, but landscape surveys such as at Saltbaek Vig and Als in Denmark and Ystad in Scania indicate much more diversity in TRB settlement locations (Price, 1996; Sørensen *et al.*, 2001). Most TRB settlement sites are extremely ephemeral seasonal camps (Madsen, 1982; Tilley, 1996).

The major fixed points in the landscape were burial monuments such as earthen long barrows with timber burial chambers (a kind of 'cultural rhetoric of Neolithization' in their similarities to LBK houses: Sherratt, 1990, 1995), and ceremonial circular enclosures with multiple entrances, 'causewayed camps' (Madsen, 1988). In southern Scandinavia there are also many bog sacrifices, ranging from simple pots with a few animal or human bones inside to significant structures such as wooden platforms with sacrifices of cattle or people, some of the latter (like the bones in some of the barrows) bearing evidence of cannibalism (Bennike, 1999; Koch, 1999). Food remains at the causewayed camps indicate feasting, especially of cattle (N. H. Andersen, 1993). By 3000 BC people in Scandinavia had built some 30,000 burial mounds (on the evidence of what survives today, and many have been ploughed out). The occurrence of flint mines in Denmark, shafts dug into the ground, also bears witness not just to economic needs for raw materials but also to new 'mental templates' of people more willing than their forebears to excavate

and manipulate the earth's surface. All this evidence points to significant community involvement and participation in the creation and maintenance of new social behaviours. Along with the processes of 'substitution' and 'consolidation' in the acquisition of agriculture, there had clearly been a profound shift in people's perceptions of the world and of their place within it (Larsson, 2004*b*).

By the end of the fourth millennium BC, the Middle Neolithic, a significant commitment to farming had developed in southern Scandinavia. Clusters of megalithic tombs and more substantial settlements indicate the development of greater sedentism and territoriality. The ard (the simple scratch plough) started to be used as well as hand digging tools. Pollen diagrams register the first evidence for people having a significant impact on the landscape through clearance activities, in part to collect fodder for livestock and in part to open up the landscape for crops and livestock. The reliance on food production was associated with elaborate burial rituals and trade in exotic materials as individuals and communities increasingly competed for power and resources. Though the most visible components of the latter in the archaeological record are the prestige trade items, it probably also involved livestock, land, and people.

Similar processes of acculturation can be discerned along the Atlantic seaboard from the Netherlands to Britanny, and in the alpine foreland (Whittle, 1996). Processes of acculturation and contact between foragers and neighbouring LBK farmers have been particularly well studied in the Rhine delta region (Raemaekers, 1999, 2003). Domesticated livestock were present at Swifterbant, De Bruin, and Brandwijk by about 4500 BC, and they also reached Doel in the Schelde estuary in Belgium through the same centuries (Cromb   *et al.*, 2002), in all cases kept on a very small scale as far as we can tell (though of course their social role may have been very different). Cereals are not recorded at Swifterbant until 4100 BC. There is then the same evidence as in southern Scandinavia for the rather rapid development of mixed farming and foraging after the long period of forager-farmer contact, characterized by similar patterns of mobility 'tethered' to ritual monuments, before the eventual commitment to farming in the more developed phases of the Neolithic cultural sequence (Louwe-Kooijmans, 1986; Raemaekers, 1999; Zeiler, 1991).

There was a parallel, and broadly contemporary, sequence in western France (Bukach, 2004; Patton, 1994; Scarre, 1998*a*, 1998*b*; Schulting *et al.*, 2004). Foragers in and around the Paris basin acquired pottery and livestock in a piecemeal fashion from LBK agricultural communities (Scarre, 2002). In Britanny, the large numbers of Neolithic burial monuments were for long assumed to mark a landscape of fixed farming communities, and the isotope

data of people buried in Hoëdic and Téviec show the same sudden switch from marine to terrestrial foods as in Denmark (Schulting and Richards, 2002b), but detailed surveys indicate a transitory, mobile landscape of forager-farmers in the Early Neolithic (Scarre, 2001). The same seems now to have been the case in the alpine foreland regions of France and Switzerland, despite the long-held assumption that their 'lake villages' represented sedentary farming communities (Pétrequin *et al.*, 1998).

Why did the foragers of southern Scandinavia and elsewhere in north-west Europe become farmers? In the case of Denmark, it has been suggested that sedentism might have stimulated population growth, forcing Mesolithic foragers to abandon foraging and commit to the more productive though more laboursome system of farming (Blankholm, 1987), but the Saltbaek Vig and Ystad surveys show no increase from the Ertebølle to the TRB populations, just a more dispersed population. Other theories have been that foraging systems came under some kind of ecological pressure, either natural or humanly induced. An example of this was Rowley-Conwy's proposal (1981a) that sea-level changes in the Baltic affected critical food supplies such as shellfish, because there was a significant decrease in the size of oysters at the time of the adoption of domesticates that, he suggested, was likely to be the result of over-exploitation. However, though the teeth of Danish Early Neolithic skeletons are less abraded and have more signs of dental decay than those of Mesolithic skeletons, this is generally assumed to reflect the increasing importance of carbohydrates in the diet, and there are no obvious signs in the human skeletal record of major food stress (Tauber, 1986). The more seasonal, drier, and more open landscapes that developed with the Sub-Boreal climate would certainly have been poorer in wild plant foods than the Atlantic forests (Bonsall *et al.*, 2002), and at the same time more favourable to domestic cereals (Dark and Gent, 2001) and livestock such as sheep. Another theory has been that high-status individuals amongst the Ertebølle foraging communities saw advantages in acquiring domestic crops and/or livestock so that they could generate additional food surpluses to enhance their prestige, for example in feasting ceremonies (Jennbert, 1985, 1987), though the most visible signs of technologies being developed to create food surpluses (enormous weirs designed for trapping fish and eels) are in fact TRB in date (Pedersen, 1997). On present evidence it seems most likely to have been a combination of natural and cultural factors. With increasingly competitive relations both within their own societies and with neighbouring farmers coinciding with ecological conditions that were becoming both less favourable to the traditional system of forest foraging and more favourable to the new resources, the foragers of the Atlantic and Baltic regions may have been drawn inexorably into combining farming

with foraging, with all the profound transformations in social relations and ideologies that that entailed.

TRANSITIONS TO FARMING IN BRITAIN AND IRELAND

One of the cornerstones of British and Irish prehistory has been the theory that farming was brought to these islands as a mature agricultural system by Neolithic colonists from mainland Europe. The practicalities of such an event were brilliantly discussed by Case (1969), who suggested that pioneer groups of colonists must have crossed the Channel in skin boats during the summer and autumn months, bringing with them their seedcorn and breeding livestock. Recent discussions, however, have increasingly tended to favour models of acculturation along the lines of those proposed for southern Scandinavia and Atlantic Europe (Armit and Finlayson, 1992; R. Bradley, 1993; J. Thomas, 1988, 1991, 1999; Thorpe, 1996; Whittle, 1996). Though this is fast becoming the new orthodoxy, it has to be recognized that, whilst there are many locations that have produced mixed surface lithic assemblages with both Mesolithic and Neolithic typical artefacts (leading to debates about whether they represent successive visits to the location by Mesolithic foragers and then Neolithic farmers, or visits by 'acculturated Mesolithic people' practising both foraging and farming), there are still no sites with good stratigraphies spanning the fifth and fourth millennia BC, the assumed transitional phase (Woodman, 2000). Most of the argument, therefore, has to focus on different interpretations of the Neolithic evidence, and as Rowley-Conwy (2004) has pointed out, the emerging new orthodoxy of gradual acculturation and a seamless transition to agriculture is in danger of resting more on consensual post-processual theorizing and less on considered appraisals of difficult, inconsistent, and intractable data.

Domestic cereals and sheep and goats (and perhaps domestic cattle and pigs, too) seem to have been introduced to Britain and Ireland from mainland Europe more or less at the beginning of the Sub-Boreal, at about the same time as their initial presence in Atlantic Europe. Cereal farming has sometimes been proposed earlier than this from palynological evidence, but the evidence is not very convincing. Of course there is no doubt that, prior to this, the maritime-orientated foraging communities of north-west Europe had long had the sailing technologies and expertise to maintain contacts between the communities of Britain and Ireland and those on the other side of the Channel. In terms of geography it is at first sight surprising that the first evidence for the significant inclusion of domesticates into local foraging systems increasingly appears to be in northern and western Scotland and Ireland, rather than the parts of

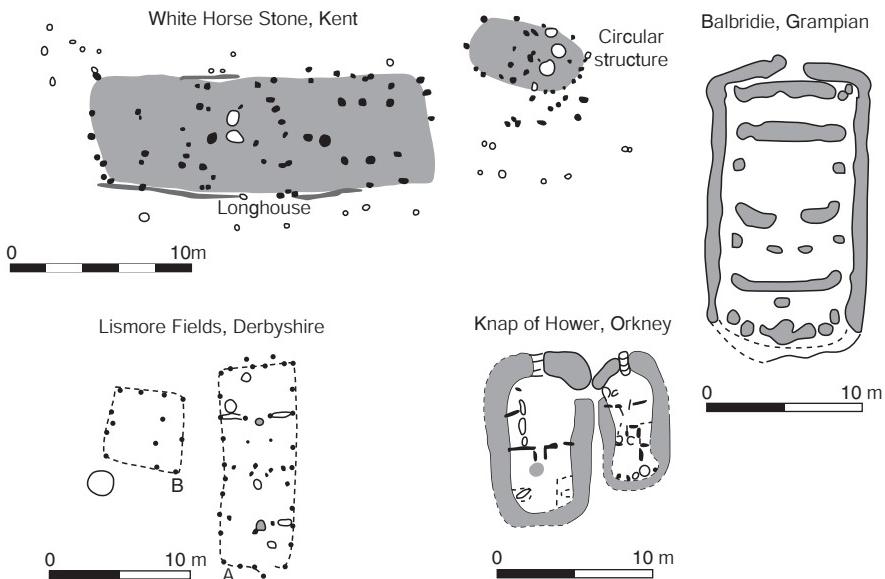


Fig. 9.17. Some Neolithic houses in Britain (after Malone, 2001: figs 21, 22, 23)

southern England closest to mainland Europe. However, in many respects the natural sailing routes following winds and currents follow the western and eastern shores of mainland Britain rather than directly across the Channel (Noble, 2003).

Discussions of the beginnings of farming in Britain were for long dominated by the evidence of Neolithic sites in Wessex, central-southern England, especially ceremonial monuments and burial mounds: classic sites such as the Windmill Hill causewayed camp (Smith, 1965) and the West Kennett long barrow (Piggott, 1962). Recent decades, though, have seen an explosion of work on Neolithic settlement throughout Britain and Ireland. This has included the discovery and excavation of a large series of habitation sites (Darvill and Thomas, 1996; Rowley-Conwy, 2003), as well as modern investigations of causewayed camps, burial mounds, and other sites such as stone quarries and flint mines (Darvill, 1987; Malone, 2001). The Neolithic record is hugely richer and more varied, though still ambiguous.

The settlement evidence is certainly extremely varied. Substantial Early Neolithic timber buildings not dissimilar to LBK longhouses include examples at White Horse Stone near Maidstone in southern England, Lismore Fields near Buxton in central England, and Balbridie, Callander, and Crathes in Scotland, though most timber buildings seem to have been much smaller,

like Building II at Lismore Fields (Fig. 9.17). It is also likely that some of the ‘longhouses’ may in fact have been primarily ceremonial structures—Warren Field near Balbridie and Crathes, for example, consists of a rectangular timber structure and an enigmatic pit alignment. Most Neolithic domestic structures have been found in the islands of Orkney and Shetland north of the Scottish mainland and in Ireland, some of them protected by stone revetments and wooden palisades (Barclay, 1996; Grogan, 1996). In England, many small structures have also been found during excavations of barrows, on the underlying land surfaces (Darvill, 1996). Most of the habitation evidence suggests small social units repeatedly using fixed locations, and frequently rebuilding structures. Intensive fieldwalking surveys of blocks of terrain in southern England, for example on the Wessex chalk downs (such as around Stonehenge, Avebury, Dorchester, and on Cranborne Chase), in the upper Thames valley, and in the Nene valley on the edges of the fens of eastern England, have commonly just found surface concentrations of Early Neolithic material (lithics and sherds). Follow-up excavations have found a few pits, with no sign of above-ground structures having been built, indicative of seasonal visits.

Amidst these landscapes of mobility, however, were major monuments, the most substantial of which were ‘causewayed enclosures’ or ‘causewayed camps’, over 70 of which are now known in Britain, their initial construction dating to about 3700 cal. bc. As in Atlantic France and southern Scandinavia, they consist of circular ditched enclosures with several entrances or gaps, representing a considerable investment in labour. Most occupy prominent places in the present-day landscape, such as Windmill Hill and Knap Hill on the Wessex downs (Fig. 9.18, lower map), but others such as Etton and Haddenham in the East Anglian fenland were by streams and rivers in lowland situations. Excavations of the ditches have found dumps of tools and tool waste, animal bones, and human and animal burials. The evidence variously indicates domestic, economic, mortuary, industrial, and especially ceremonial/ritual activities such as ritual deposition, sacrifice, and feasting. They appear to have been ritual or ceremonial centres for the dispersed communities living around them, ‘arenas for the celebration of the collective’ in Mark Edmonds’s phrase (1999: 150). Some of them had a defensive function as well, though, the best-known examples being Hambledon Hill and Crickley Hill with their evidence of burnt palisades and arrow-shot individuals.

The third major category of evidence for the character of Early Neolithic societies in Britain is their burial mounds; the emerging radiocarbon chronologies indicate that the first of these preceded the causewayed camps by a century or so. Some barrows have visible features built of large stones (hence ‘megalithic’) such as façades, kerbs, outworks, and chambers, and as

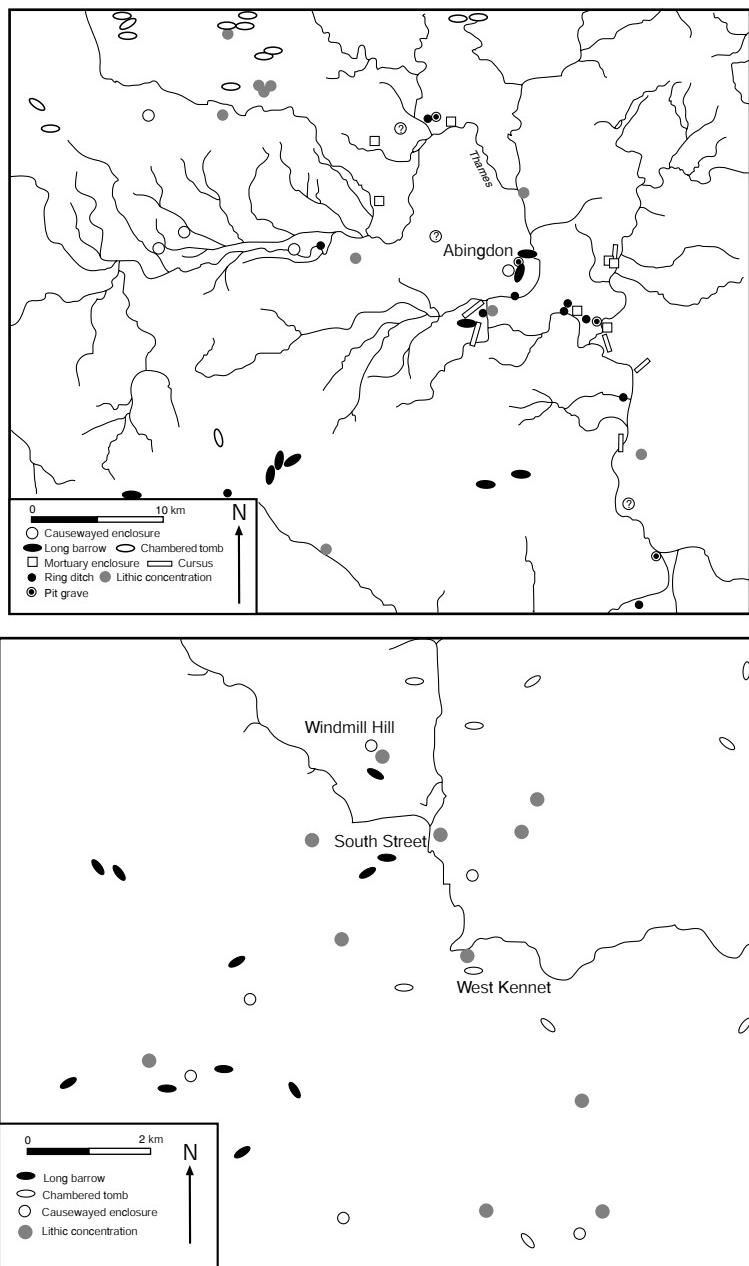


Fig. 9.18. Early Neolithic landscapes in southern England: (*above*) the upper Thames valley; (*below*) the Avebury district (after J. Thomas, 1999: figs 8.1 and 9.1)

with many tombs in the Atlantic and Baltic regions, analogies can be drawn in some cases with longhouse design. In recent decades excavations of Neolithic barrows have invariably demonstrated complex construction and use histories enduring many centuries. Distinctive regional styles can be recognized, but the dominant feature is that most appear to have been used for multiple or 'collective' burials, though it is clear that only selected individuals, not whole communities, were buried in these places. There were extremely elaborate rituals, probably including the careful preparation of the ground, perhaps for ritual purification; this is one interpretation of the famous criss-cross grooves in the chalk bedrock interpreted as plough marks under the South Street barrow near the Windmill Hill causewayed enclosure (Evans, 1971). Some bodies were buried whole, others disarticulated, some seem to have been exposed first and then the cleaned bones carefully buried, some were deliberately defleshed, others burnt. The remains were variously placed in pits, chamber floors, or on raised platforms. The treatment of animals was just as complex (A. Jones and Richards, 2003). All of this suggests the profound importance of concepts of ancestry for these Early Neolithic communities. The living passed through 'liminal' or boundary stages (the burial rites, and the ensuing burial) to become anonymous ancestors from whom descent could be claimed, legitimating a community's links to landscape and an individual's claims to social position and resources.

Perhaps the strangest examples of ceremonial monuments built by Early Neolithic people in Britain were long narrow 'cursuses' (so named from the antiquarian William Stukeley's observation in the eighteenth century that they were likely to be the race courses of ancient Britons). Over 100 are known, varying in length from 150 metres or so to almost 10 kilometres, and marked out by banks and ditches 20–120 metres apart. Similar ceremonial spaces were also delineated by rows of pits. It is not clear, as with the causewayed enclosures and burial mounds, the extent to which the act of building (and rebuilding) was in itself the primary purpose, or the activities then carried out within the demarcated space. Enclosing space in a formalized way in all these various categories of monument could have been as much to restrict access to some people in a community as to allow access to others. However mobile and small-scale these Early Neolithic societies were, they were clearly highly structured.

Much of the evidence for subsistence, in the form of animal bones and plant remains, has been obtained from excavations of causewayed enclosures and burial mounds, and clearly derives from rituals and ceremonies. The full range of cereals and legumes and domestic livestock is recorded, as well as wild plants and animals. Young female cattle frequently dominate the faunal samples of the causewayed enclosures, particular animals being specially

selected and brought to these locations for communal feasts (Legge, 1981). Both wild animals and livestock, but cattle especially, were killed as part of the rituals at the burial mounds (Entwhistle and Grant, 1989), the rituals suggesting that there were important ties of emotion between people and cattle (Ray and Thomas, 2003). In lowland England the frequency of causewayed enclosures, burial mounds, and the generally ephemeral habitation evidence (Fig. 9.18), are generally interpreted now in terms of the same notion of 'tethered mobility' as is being applied to many other Early Neolithic societies in north-west Europe. Mobile Early Neolithic communities combined foraging and farming (especially herding). Their tenure of the particular landscapes they inhabited was legitimated by ancestral burial places, their social cohesion maintained by the ceremonies at the causewayed enclosures and cursuses (J. Thomas, 1991, 1999). These landscapes appear to have been a mosaic of woodland and small clearings, both of which would have been important for foraging, grazing, and small-scale cultivation (K. J. Edwards, 1993; French *et al.*, 2003). The physical impact of people on landscape at this time was on a tiny scale.

Contrasting with the subsistence mobility of the people inhabiting these markedly ritualized landscapes in regions such as Wessex, there are examples elsewhere of landscapes being marked out and formally demarcated by field walls. Most remarkable, perhaps, is the system of parallel rectangular fields buried under bog at Céide in western Ireland (Caulfield, 1978; Caulfield *et al.*, 1998; Fig. 9.19). Somewhat comparable fields, in this case marked by ditches, have been found at Fengate in Cambridgeshire. They clearly suggest very different forms of land use and concepts of land tenure than in Wessex, though

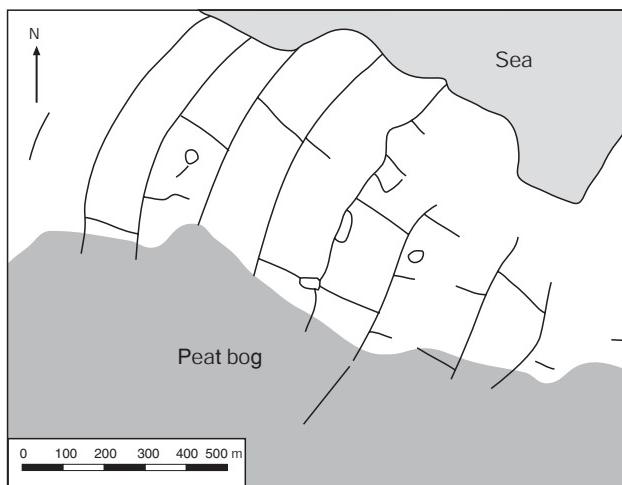


Fig. 9.19. The Neolithic co-axial field systems at Céide, County Mayo, Eire (after Barker, 1985: fig. 79)

Fig. 9.20. The Sweet Track, a Neolithic trackway built across the Somerset Levels marshland in south-west England (photograph kindly provided by John Coles; copyright Somerset Levels Project)



both are thought to be related to cattle-keeping rather than crop husbandry. Another example of landscape management, in this case of the 'wildscape', is the timber trackways built across what were then the marshes and fens of the Somerset Levels in south-west England, probably in part to facilitate movement between adjacent drylands and in part to give access to wetland grazing and hunting grounds (Coles and Coles, 1986; Fig. 9.20). Trees on the surrounding hills were carefully coppiced to produce suitable timbers for the trackways, a practice also deduced from the timbers at the Etton enclosure (Pryor, 1998). The artefacts found adjacent to the trackways, as well as hints of human sacrifice, suggest that construction and use were associated with elaborate ritual (rites of passage, for example?), chiming with the ritual

deposits found in the shafts of flint mines. Monumentalized or not, the entire landscape of Early Neolithic Britain was imbued with cultural meaning and memory for its forager-farmers (R. Bradley, 2000).

The respective contributions of foraging and farming to the diet of Early Neolithic communities in Britain and Ireland are uncertain, and much debated. The isotope evidence from British Mesolithic and Neolithic skeletons suggests a dramatic switch from a diet dominated by marine foods to a diet dominated by terrestrial foods (M. P. Richards, 2003; Richards and Hedges, 1999; Schulting and Richards, 2002c; Schulting *et al.*, 2004), which J. Thomas (2003) has interpreted in terms of food taboos associated with the profound ideational changes involved in adopting agriculture. However, the wholesale nature of this dietary change has been disputed by Milner *et al.* (2004) especially because other palaeodietary data do not show this. In England, for example, whilst settlement sites have yielded a range of cereals and other crops (emmer and flax at Lismore Fields, for example, and emmer, bread wheat, and barley at Yarnton), and surprisingly grapes may have been cultivated as well on the evidence of pips and burnt vinewood at Hambleton Hill, wild foods seem to have been at least as important in the diet as domesticated foods at most Early Neolithic sites (G. Jones, 2000; Moffet *et al.*, 1989). The Scottish faunal and botanical evidence suggests that farming in the north was on an extremely small scale and embedded within a foraging system that was essentially the same as that practised in the Mesolithic (Armit and Finlayson, 1992). Also, there are no significant differences in the prevalence of dental caries between British Mesolithic and Neolithic skeletons, masticatory loads were much the same, and rates of tooth wear indicate that both diets were characterized by a heavy reliance on roots, tubers, nuts, and fruits (Chamberlain and Witkin, 2003). Hedges (2004) in fact, one of the main scholars involved in the isotopic work, emphasizes the need for caution with regard to the isotope data at this stage in the development of the methodology given that the level of marine resource consumption which is currently indistinguishable from terrestrial values could conceivably be as high as 30 per cent. A further difficulty is that the Neolithic isotope data come mainly from people buried in tombs, recognized to be a selected group of the general population. The faunal and botanical data at settlement sites are more likely to be representative of the wider community, but in the case of the plant remains Rowley-Conwy (2004) points out how difficult it is to establish the relative roles of wild and domestic foods because of taphonomic issues of differential representation and recovery.

It is possible, indeed likely, that the range of conflicting data does in fact reflect the reality, that domestic animals and plants were critical for most of these societies in the roles they played in social practice, but not in the

everyday diet, at least in the case of the majority of the population. For many Early Neolithic societies in Britain (and I suspect for many others in Europe), the consumption of domesticated foods may have been primarily a marker of identity and status. It is quite possible that cereals were at first as important for their magical properties of fermentation as for making bread, gruel, or porridge, just as in many traditional African societies today brewing beer is critical for many ceremonies (Dineley and Dineley, 2000). Analyses of lipid residues in Windmill Hill sherds indicate that livestock such as cattle and sheep were used for their milk products as well as for their meat, something that was traditionally thought to be a later development in the prehistory of farming (Copley *et al.*, 2003), and the blood of livestock may also have been valued for drinking. (It is interesting, though, that so far no evidence has been found of tuberculosis in British Neolithic populations, despite its propensity to cross over from domestic animals: Roberts and Cox, 2003: 62.) Given the repeated ritual associations of the domesticates at so many British Early Neolithic sites of every character, both those overtly ceremonial/ritual and those not, Parker Pearson (2003: 20) reflected that ‘the Neolithic domestication “package” of cereals, cattle, pigs, and sheep may be viewed from the consumption perspective, providing its users with a mobile feasting network in which the timing, scale, and certainty of feasts were of a higher order than amongst those communities relying on entirely wild resources’.

As in so much of mainland Europe, a significant commitment to mixed farming did not develop until later in the Neolithic, and in many parts of Britain and Ireland sedentism may not have been the norm until the parcelling up of large sections of the landscape by formalized systems of land division in the second millennium BC, the Bronze Age.

CONCLUSION

The traditional model of Neolithic agricultural colonists from South-West Asia spreading inexorably across Europe is extremely difficult to reconcile with the complexity of the evidence now available for the beginnings of agro-pastoral farming here. Agricultural communities no doubt shifted into new territories from time to time and for a variety of reasons (Rowley-Conwy, 2004: 97), just as foraging communities must have been doing ever since their recolonization of Europe after the Last Glacial Maximum onwards. Such a scenario of complex, repeated, and multidirectional mobility fits the European genetic data better than a series of major unidirectional migrations (Haak *et al.*, 2005; M. Richards *et al.*, 1996, 2000). There was clearly not a steady ‘wave of advance’ of a Neolithic package of new technologies and new forms

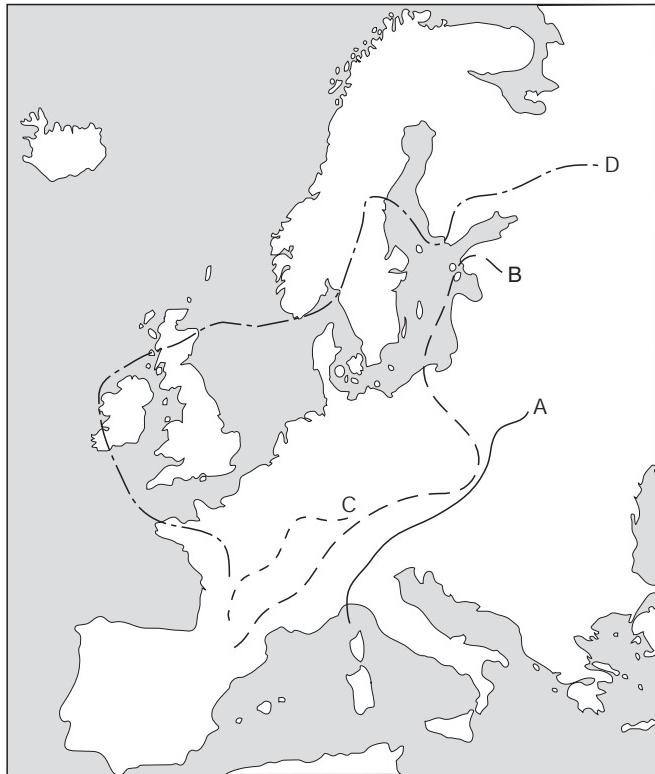
of subsistence from south-east to north-west, but rather a piecemeal process of adoption of components of the package by the indigenous foraging populations, in different environmental and cultural contexts.

The domestic dog (domesticated from the wolf) was probably already part of late Pleistocene hunting technologies. Many early Holocene foragers in Europe were practising forms of behaviour that presaged the animal and plant husbandry systems of Eurasian agro-pastoralism long before they came into contact with the latter. The exchange networks linking European foraging societies, by sea as well as land, meant that mechanisms were in place for new resources as well as ideas and people to be readily exchanged. Most Mesolithic foragers obtained the Neolithic domesticates from their neighbours as already-domesticated plants and animals, along with the knowledge about how to manage them (even if at first they often used them in different ways themselves), though the genetic evidence suggests that pigs were domesticated independently in Europe, perhaps in several locations (Kijas and Anderson, 2001; Larson *et al.*, 2005) and it is possible that cattle were domesticated independently here as well as in South-West Asia (J. F. Bailey *et al.*, 1996; Loftus *et al.*, 1994).

The expansion across Europe of an agro-pastoral system developed originally in the semi-arid regions of South-West Asia (and the eastern Mediterranean?) certainly had a climatic or ecological context (Bonsall *et al.*, 2002). The ‘elm decline’, the sudden dramatic decline in elm registered in innumerable pollen diagrams in north-west Europe, which was once explained in terms of the impact of Neolithic colonists collecting elm leaves as fodder (Rasmussen, 1990), was in fact a European-wide phenomenon (Fig. 9.21). Its retreat from south-east to north-west Europe is a useful indicator of the effect of the changing Holocene climate on European plant ecology, in particular the moving frontier of drier and more open landscapes registered in north-west Europe as the transition from the Atlantic to the Sub-Boreal vegetation/climatic zones (Table 9.1). It surely cannot be a coincidence that the expansion of the Neolithic domesticates was more or less contemporary with this expanding ecological frontier. Plants and animals exotic to Europe had to adapt to the more temperate environments they encountered, just as foragers in different parts of Europe adapted the agro-pastoral package—or the parts of it they chose to use—to the opportunities and constraints of the particular landscapes they inhabited, and embedded the domesticates into existing systems of economic and social practice (with consequences, we can see with hindsight, both expected and unexpected).

Zvelebil and Rowley-Conwy’s three-stage model of ‘availability’, ‘substitution’, and ‘consolidation’ aptly describes the process by which many foraging communities in Europe first encountered the Neolithic package, and then

Fig. 9.21. The elm decline in Europe; lines A, B, C, and D mark the approximate north-western limits of sites where elm pollen values declined markedly:
 A. c.6000–5500 BC;
 B. c.5500–4500 BC;
 C. c.4500–4000 BC;
 D. c.4000–3500 BC
 (after Dincauze, 2000: fig. A)



started to use parts of it, before developing a significant and in time irreversible commitment to mixed farming. In many parts of Europe the three stages equate crudely with (respectively) the Late Mesolithic, Early Neolithic, and the Middle and/or Late Neolithic in the local cultural sequences. Where the data and chronologies are most detailed, the encounter stage often lasted many centuries, even a millennium, but the substitution process (that is, the initial commitment to incorporating elements of cereal cultivation and animal husbandry into existing economic and social practice) then seems to have been much more short-lived, lasting in most cases a few generations (Rowley-Conwy, 2004). There is increasing evidence, even in south-east and central Europe where sedentism has long been assumed to be the correlate of early farming, that many Early Neolithic foraging-farming systems were highly mobile, frequently involving a strong herding component alongside small-scale plant cultivation (Whittle's 'tethered mobility'). Mixed foraging-farming systems continued for many centuries in most cases, before mixed farming became well established.

The conclusion that the Eurasian agro-pastoral system spread into Europe more or less by a process of acculturation of course poses many questions about why foragers reacted to it when and how they did. Some scholars have favoured 'push' models: foragers were pushed into farming because their food supplies and systems of procurement came under threat from climatic and environmental changes (particularly the drying out and opening up of the Atlantic forests), or from rising populations caused by the increasing sedentism of some coastal communities. Others have preferred 'pull' models: foragers were pulled into farming because increased sedentism brought about subtle changes in seasonal scheduling and territorial behaviour. As people became tied to particular places and to particular food sources, this provided the context in which 'manageable' resources such as domestic cereals and livestock became increasingly attractive to adopt. In north-west Europe in particular, models of social competition have been much advanced: increasingly competitive behaviours amongst particular individuals or groups of foragers made new exotic foods attractive (first to obtain, and then to produce) as prestige resources for exchange or consumption in feasting. In recent years many scholars have argued, though from various perspectives, that the transition from foraging to farming in Europe was as much about new ways of thinking about the landscape and people's place within it, as about new ways of living (R. Bradley, 1993, 1998; Hodder, 1990; Sherratt, 1990, 1995; J. Thomas, 1991, 1999, 2003; Tilley, 1996; Whittle, 1996): new ideologies as well as new social practices were subtly intertwined with any engagement with food production, a point to which I shall return in the final chapter.

10

The Agricultural Revolution in Prehistory: Why did Foragers become Farmers?

INTRODUCTION

As Chapter 1 described, the origins of agriculture have been debated by archaeologists for most of the discipline's history. The topic has been a particular focus of archaeological field and laboratory research from the middle of the twentieth century onwards. The number of suggested causes that has been proposed over the years for why prehistoric foragers might have become farmers appears almost endless, with everybody joining the party including the lunatic fringe (Table 10.1)! The main course of scholarly debate, though, has been conditioned partly by changing theoretical currents in archaeological thinking and perceptions of present-day or recent foraging and farming societies (Chapter 2) and partly by the application of improved methodologies (Chapter 3). In the regional studies that form the core of this book, I have concentrated primarily on the archaeological evidence left by prehistoric foragers and farmers, in all its richness, from stones to bones to rock art to starch grains (and more besides), though I have also made reference to the contributions of the several other disciplines that have contributed to the debate, including anthropology, ecology, ethnoarchaeology, genetics, geomorphology, linguistics, and palynology (pollen analysis). The next sections briefly review the principal themes that have emerged from those studies, as the basis for some concluding reflections on whether it is possible or desirable to arrive at an overarching explanation or set of explanations for why foragers became farmers.

SOUTH-WEST ASIA

South-West Asia has probably been the focus of more debate on discussions about the origins of agriculture than anywhere else in the world. On the present evidence what can clearly be recognized as the Eurasian system of

Table 10.1. Some of the causes that have been proposed for the transition from foraging to farming

aliens
big men
broad spectrum adaptation
circumscription
climatic change
competition
desertification
diffusion
domesticability
energetics
familiarity
fat intake
feasting
geniuses
hormones
intelligence
kitchen gardening
land ownership
multicausal
marginal environments
natural habitat
natural selection
nutritional stress
oases
plant migration
population growth
population pressure
random genetic kicks
resource concentration
resource pressure
rich environments
rituals
scheduling conflicts
sedentism
storage
technological innovation
water access
xenophobia
zoological diversity

Adapted from Gebauer and Price, 1992b: table 1.

mixed farming (the cultivation of wheat and barley and the herding of sheep and goats) seems to have developed in this region very early in the Holocene. It underpinned the dramatic development of PPNB villages in and around the 'hilly flanks' of the Fertile Crescent some 1,000 years into the Holocene, c.8500 BC. The parts of South-West Asia where these villages came into

being were also places where wild cereals, sheep, and goats were naturally located. For some years now the textbook orthodoxy has been that wild cereals were taken into cultivation in the PPNA at the beginning of the Holocene (*c.*9500 bc) in the western part of the region (the Levant); wild sheep and goats were domesticated in the eastern part (the Zagros mountains of Iraq and Iran); and plant and animal husbandry then came together in the PPNB as the Eurasian farming system.

However, the recent discovery of the extraordinary PPNA monumental complex at Göbekli Tepe in south-eastern Turkey (Schmidt, 2001) emphasizes the fact that very large areas of South-West Asia still remain under-researched (or even, for all practical purposes, un-researched) in terms of targeted field-work to a modern standard, as a result of decades of political instabilities and tensions. This applies both to where archaeological surveys and excavations have not taken place, and where botanical and zoological fieldwork has not been undertaken with the aim of modelling the likely distributions of wild cereals, sheep, and goats (including now from the DNA patterns in modern landrace species). If the distribution of modern wild forms of the cereals and sheep and goats is a general guide to the potential ‘hearth(s) of domestication’ of the Eurasian farming system, then theoretically the zone of interest of the ‘Near Eastern hearth of domestication’ should probably stretch from Gibraltar in the west to Quetta in Pakistan to the east, and from Cairo in the south to the Crimea (and Belgrade?) in the north. That various species of wild wheat, barley, and legumes were being gathered throughout the Mediterranean in the early Holocene (Chapter 9) is a timely reminder of the dangers of decades of research focused in one or two small parts of that huge area proving to be self-fulfilling prophecies about their unique status as ‘the primary hearth of domestication’ of a particular type of plant or animal.

The second objection we should make to the orthodox theory is that the archaeological data from Israel, Jordan, Syria, and Turkey make it quite clear that we are studying a very long-lived process or processes, not a ‘PPNA event’. Practices that can be identified as having many characteristics of animal and/or plant husbandry were being undertaken by the Natufians 5,000 years before the PPNA. However, we can also see that Natufian behaviour was profoundly affected by the dramatic climatic and resultant ecological changes after the Last Glacial Maximum. The sudden return to the markedly cold and arid conditions of the Younger Dryas in particular changed the distributions, densities, and seasonal availability of key plants and animals. Herds of gazelle, for example, a species well suited to the return to arid conditions, expanded their range, whereas the wheats and barleys contracted into better-watered refugia. People had to respond to the profound changes brought about to the landscapes in which they lived by the Pleistocene–Holocene transition, and clearly did so.

The last point introduces another important observation of general applicability for any general theory about the agricultural revolution in prehistory: that people then as now had choices and took decisions in historically contingent circumstances. The population of South-West Asia responded to the threats and opportunities of profound landscape change in the millennia on either side of the Pleistocene–Holocene boundary in different ways. Some maintained existing modes of subsistence by moving to new areas; others diversified; and others intensified in ways that were to develop into what in time becomes recognizable to us as the Eurasian system of mixed farming. Developing a reliance on domesticated cereals, in particular, can be understood as an irrevocable step, because the demands of time and labour involved in ground preparation, planting, weeding, protection from predators, and harvesting were, cumulatively, more or less all-year-round and were not easily compatible with mobile foraging.

Although scholars disagree about whether changes in ideology in South-West Asia came before or after changes in subsistence, or whether both developed in tandem in a ‘positive feedback’ relationship, the debate very usefully underlines another observation of general applicability to this inquiry: that the transition from foraging to farming was as much a social and psychological as an economic and technological process. To change from foraging to farming ultimately involved profound transformations in ways of *thinking* and *being* as well as *doing*. ‘As a “privatization” of resources it marked the end of the forager sharing ethic, and as a commitment to a more permanent corporation it created new roles both for the living and the dead’ (Sherratt, 1997: 276).

CENTRAL AND SOUTH ASIA

The current orthodoxy for the beginnings of farming in Central and South Asia has been that Indo-European PPNB farmers migrated eastwards from the Zagros across the Iranian plateau to Turkmenistan, Afghanistan, and Pakistan, and Dravidian rice farmers from East Asia migrated westwards to the Ganga (Ganges) valley. This kind of model was first proposed, like the Neolithic colonization of Europe, at a time when the archaeological evidence for early farmers was thin on the ground and that of the ‘recipient forager population’ hardly existed at all. The data base is still exiguous, but certainly no longer fits theories of agriculture beginning in Central and South Asia as a result of Indo-European and Dravidian migrations.

As mentioned in the previous section, there is no a priori reason why cereal and sheep/goat husbandry is not at least as old in this part of the distribution zone of the wild progenitors as in the better-researched parts of the hilly flanks of the Fertile Crescent. The distinctive nature of the kind

of mixed farming that developed contemporary with PPNB farming to the west (which included durum wheat, date, and cotton), together with DNA studies of modern cereals and livestock, imply that this may well have been the case. In the Ganga valley, foragers were harvesting wild rice very early in the Holocene (at least), and by the time farming villages had developed to the west like Jeitun and Mehrgahr, the rich food resources of the Ganga valley sustained complex (semi-sedentary?) foraging societies who may have been practising rice horticulture long before any putative Dravidian migration of rice farmers from East Asia. The recent realization that rice farming almost certainly began independently in the Ganga valley poses many questions about the environmental and social contexts in which it happened that have hardly been asked by scholars, let alone addressed with new fieldwork. The same is true of the gathering evidence that several indigenous millets and pulses were probably domesticated in central and southern India in a process independent of Harappan agriculture.

Another finding of general significance to wider models of foraging-farming transitions is the evidence for the movements of resources over huge distances, linking very different kinds of farming and foraging societies. Whatever the intermediaries, Indus valley farmers may have acquired some of their millets and pulses through trade variously with Oman (1,250 kilometres away), Mesopotamia (2,500 kilometres), East Africa (3,000 kilometres), and central/southern India (1,000 kilometres), and rice from the forager-farmers of the Ganga valley (1,000 kilometres).

Finally, the hugely improved database of well-dated sites with well-studied subsistence data makes it quite clear that the beginnings of millet/cattle farming systems in central and southern India were characterized not by the steady ‘wave of advance’ predicted by colonist migration models but rather by ‘punctuated explosive dispersal’. I have argued that the dominant process was the acquisition of domesticates by indigenous foragers, at different rates and in different ways, and in the initial phases of use perhaps more for their value as status items than as food staples.

EAST AND SOUTH-EAST ASIA

South-East Asia has provided some of the most remarkable evidence anywhere in the world for the antiquity of ‘husbandry-like’ behaviours by modern human foragers, more or less from the time they first encountered these landscapes c.50,000 years ago: burning forest, exploiting forest tubers, processing potentially toxic plants, and moving food resources from island to island. After the LGM people were systematically harvesting wild millet in northern China

and wild rice in southern China, and it is quite likely that, like the Natufians, they were beginning to develop forms of horticulture in the Bølling–Allerød interstadial, and like them, domesticating the dog as an aid to hunting. The ensuing development of agricultural systems also has many similarities to that of South-West Asia: a return to broad-spectrum foraging (as far as we can tell) in the Younger Dryas; a variety of mixed foraging/cultivating and foraging/herding systems re-established in the first thousand years of the Holocene; and then the rapid development of a commitment to mixed farming, resulting in (on present evidence) rice-farming communities *c.*7500 BC in the Yangzi valley and millet-farming communities in the Huanghe valley *c.*6500 BC.

Contemporary with these people there were more or less sedentary foraging societies in mainland South-East Asia, Korea, and Japan, their subsistence sustained especially by marine foods. They acquired domesticates through their far-flung exchange networks, quite possibly first as prestige items, though on the evidence of Khok Phanom Di farming communities may also have been moving out from the Chinese agricultural heartlands, and marrying into forager communities. By the mid-Holocene these foragers demonstrate a more significant commitment to agriculture: they cultivated millet and rice in Korea; buckwheat, green grams, the beefsteak plant, rice, and millets in Japan; and rice, taro, and yam in mainland South-East Asia. Intensive mixed farming, including paddy-rice farming (using the water buffalo?) and the use of metal tools, then developed in the mid-second millennium BC in Korea and mainland South-East Asia, and in Japan a few centuries later, in each case in the context of the emergence of complex stratified societies.

Throughout the vast regions of Island South-East Asia and the inhabited parts of the Pacific, including quite possibly Australia, foragers in the early Holocene engaged in various forms of arboriculture and horticulture, exploiting a mix of local and non-local resources, the latter acquired by seaborne exchange. The emerging complexity of the archaeological evidence for transitions to farming in Island South-East Asia is at variance with the orthodox archaeological/linguistic thesis of an Austronesian Neolithic dispersal from mainland China. It also chimes with the complexity of the population histories being revealed by DNA studies of modern humans, plants, and animals (including commensals such as the rat). At one end of the spectrum is the evidence for long-lived systems of forest horticulture, including the Kuk taro fields in New Guinea that may be amongst the earliest agricultural systems anywhere in the world. At the other is the late and explosive spread of rice, domestic pigs, and Lapita material culture across Melanesia (but not Australia) *c.*2500/1500 BC. Rice and pigs may have been

acquired first because people valued them as luxury foods and/or prestige goods, and it is conceivable that the proto-Austronesian language spread as an associated status marker or lingua franca, too, a point to which I return later.

THE AMERICAS

Phytolith evidence suggests that the deliberate cultivation of roots and tubers such as arrowroot, manioc, and yam could have begun in the tropical regions of Central and South America in the late Pleistocene, not so long after their initial colonization. Throughout the Americas a wide variety of plants was being harvested, manipulated, and taken under control by foragers through the early and mid-Holocene: the tropical roots and tubers; the agave cactuses, squashes, and maize in Central America; and squashes and floodplain weedy plants (such as marsh elder, sunflower, goosefoot, and knotweed) in the eastern Woodlands of North America. Various scenarios have been proposed for why plant cultivation began in the Americas. One theory (proposed with reference to the tropical regions) is that foragers were pushed into it in the tropical regions because the Holocene climate resulted in wetter denser forests that were harder to exploit than late Pleistocene landscapes. In this theory, horticulture made desirable foods more reliable and accessible (Piperno and Pearsall, 1998). Another (proposed for the eastern Woodlands) is that foragers were pulled into agriculture because climatic trends encouraged more sedentary foraging: plant cultivation was 'a stress-free opportunistic undertaking... in a context of relative subsistence abundance and security' (B. D. Smith, 1995b: 212). A third theory, proposed for the arid South-Western United States, is that foragers started to use maize and other crops not to *change* their way of life but to *preserve* it, by reducing risk and increasing resource predictability when existing lifeways were under threat from ecological change; horticulture was a tactical shift to reduce risk over the worst time of the year, the 'hungry gap' (Wills, 1992). A fourth theory, developed first for upland Mexico, is that foragers were attracted to exotic plant resources as prestige items in the context of socio-economic competition (Hayden, 1995). Maize, like rice in South-East Asia, may have had a primary attraction for many foraging communities as a status crop for brewing alcoholic beverages (Raymond, 1993), though it swiftly developed as the staple food of hierarchically based agricultural societies and the pre-Columbian states. Still another theory is that foragers' shamans were attracted to plants like gourds to keep their medicines in, or to use them as magical rattles (Prentice, 1986).

AFRICA

By the late Pleistocene, foraging sustained more or less sedentary communities in some favoured locations in North Africa like the Nile valley. Although the main domesticates have long been assumed to have been introduced from South-West Asia to the Nile valley by PPNB migrant farmers, who in due course then spread across the Sahara, DNA evidence for independent domestication histories of cattle in North Africa chimes with the archaeological evidence for the development of farming systems here independent of South-West Asia. It is quite likely that floodplain weed horticulture on the American model developed in the Nile valley in the early Holocene, based on plants such as nut-grass, club-rush, ferns, and dom palm, before the cultivation of sorghum, wheat, and barley. Cereal cultivation in time became attractive as a more effective means of compensating for the unpredictability of the Nile flooding regime (Wetterstrom, 1993, 1998). The foragers who expanded fast throughout the Sahara in the markedly wet climates of the early Holocene appear to have experimented with controlling wild Barbary sheep as a response to the first sharp trend to aridification, perhaps as a way of reducing risk. With the ensuing return to wetter climates they reverted to pre-existing systems of foraging, rather in the way that Natufians did in the Younger Dryas, though in response to reverse climatic trends. A few centuries later, in the face of real and irreversible desiccation, they committed to cattle, sheep, and goat pastoralism (with animals acquired from the Nile valley?), and to small-scale sorghum cultivation.

Desiccation also pushed some of these people southwards into the Sahel, where foragers, pastoralists, and fishing communities lived side by side before cattle and millet pastoralism became widespread after c.2000 BC, when a series of hierarchical societies developed for whom cattle were the critical means of signifying wealth and power. On current evidence farming in the tropical rainforests of West Africa also began after c.2000 BC with the cultivation of plants like oil palm and Canarium. A link with iron technology may have been important here in terms of the improved technologies for forest clearance that it made possible. However, given the remarkable recent evidence at Nkang in Cameroon in the first millennium BC, for phytoliths of banana, an imported crop from South-East Asia, and bearing in mind the phytolith, parenchyma, and starch data from the Asian and American tropical regions, it is highly unlikely that the current findings are anything but a *terminus ante quem* for when forest horticulture began in West Africa.

The development of farming in East and South Africa has traditionally been envisaged, like that of the Indian sub-continent and South-East Asia, as the spread of a new people, in this case the forebears of the present-day Bantu,

taking with them new material culture (Early Iron Age pottery and other artefacts), a new language (proto-Bantu), and farming based especially on cattle and sorghum. As in those regions, the stop-and-start pattern of spread, the different degrees of use of the domesticates when farming started to be practised, and the many linkages with the material culture and subsistence modes of the pre-existing inhabitants, all suggest that we are primarily dealing with complex processes of acculturation, though population movements at a variety of scales (and variously by foragers, farmers, and forager-farmers) were no doubt part of the process by which domesticates and their use spread southwards. Dispensing wholly or largely with Bantu migrants, though, exposes how little we understand of the particular circumstances in which foragers decided to commit to farming, and why. The social role of sorghum for beer and of sheep and cattle as wealth on the hoof may well have been an important stimulus to their initial acquisition, though presumably not in all circumstances.

EUROPE

The quality of the evidence in Europe in terms of the indicators listed in the preceding paragraph makes the case for a wave (or waves) of advance of Neolithic migrant farmers from South-West Asia particularly unlikely. The dog had probably already been domesticated in the Pleistocene. Many Mesolithic foragers were practising forms of behaviour that presaged the animal and plant husbandry systems of Eurasian agro-pastoralism long before they came into contact with the latter. There was then a piecemeal process of adoption of components of the 'Neolithic package' by the indigenous foraging populations. The archaeological record has many examples of foragers and farmers living side by side for centuries, and being in contact with one another, with hints in the isotope data of intermarrying. Many communities lived as forager-horticulturalists and/or forager-herders long after they first encountered the South-West Asian (and Mediterranean?) domesticates. A common sequence, in fact, is for a long-lived period of interaction between foragers and farmers (or, rather, farmer-foragers in most instances) being succeeded by a relatively sharply defined phase in which the foragers developed a significant commitment to aspects of the Neolithic package, sometimes over just one or two generations. For many of these societies their initial involvement may have been as much or more to do with the social value of exotic foods (and of livestock on the hoof) than with the domesticates' potential role as food staples. One of the most striking features of the adoption of domesticates in parts of north-west Europe, contrary to the traditional theories of the impact of

agriculture on foragers, was that sedentary or semi-sedentary systems of land occupation based on foraging appear to have been transformed into much more mobile systems based on foraging-cum-farming. These were associated with profound changes in ideologies typified by the construction of an array of elaborate ceremonial monuments that were (as far as we can tell) the principal fixed points in Neolithic landscapes of ‘tethered mobility’.

The frequency of terms for farming in what are thought to have been very early stages in the development of the Indo-European language group has been interpreted in terms of proto-Indo-European-speaking Neolithic colonists spreading out from South-West Asia and taking agriculture with them westwards into Europe and eastwards into South Asia (Diamond and Bellwood, 2003; Renfrew, 1987, 2003). On the linguistic side, a noted weakness of the correlation with the first farmers has been the fact that the reconstructed proto-Indo-European lexicon has a strong bias towards domesticated animals rather than plants, and also has words for wheels and wheeled vehicles, inventions that certainly post-date the Early Neolithic. On the archaeological side, the chronology of the first appearance of domesticates in different parts of Europe does not fit any model of steady spread; and the complexity of the processes of transition from foraging to farming and the variable contexts of the initial use of domesticates sit uneasily alongside the predictions of a theory of Neolithic colonist farmers from South-West Asia. The genetic data from European populations point to a similar complexity in population histories, with little genetic input from incomers at the time of the Neolithic (Haak *et al.*, 2005; Richards *et al.*, 1996). So what then of the importance of agricultural words noted by linguists in their models of the proto-Indo-European language? If such a linkage is valid, as it seems to be, then we are left with the fascinating implication that speaking proto-Indo-European was part of what being a farmer meant wherever foragers engaged in the Eurasian system of farming throughout its area of practice, from Ireland to the Indus. Certainly as far as Europe is concerned the extensive exchange networks, both marine and terrestrial, that linked European foraging populations in the early Holocene meant that mechanisms were in place for new resources, ideas, people, and language, to be readily exchanged.

SO WHY DID FORAGERS BECOME FARMERS?

The development of agriculture around the globe entailed innumerable historically contingent decisions by individuals and communities confronted by what they perceived as risks and opportunities. But they took those decisions, of course, without knowing the likely outcome. It is important that we do not

fall into the trap of evaluating those decisions with the benefit of hindsight—a tendency that has characterized so much thinking about the reasons for the agricultural revolution—from, as it were, the perspective of the supermarket check-out counter. As Diamond (1997: 106) warns, ‘what actually happened was not a *discovery* of food production, nor an *invention* … food production *evolved* as a by-product of decisions made without awareness of their consequences’. The archaeological record of forager–farmer transitions must embody many unwise and foolish decisions, including fatal miscalculations, not just successes. Too often, debates about the transition from foraging to farming are still characterized by an evolutionary approach to the past that, though more subtly expressed, is not so very different from the Victorian notions of ladders of cultural progress with which I began Chapter 1: that those prehistoric foragers who intensified their subsistence in ways that we can recognize would in time become food production were doing so because (implicit in the reasoning though never so crudely expressed) they half-knew they were on the road to the eminently desirable goal of becoming farmers. In his global review of the emergence of agriculture, Bruce Smith (1995a: 211) used the theatrical metaphor of the casting director, talent-spotting ‘the many wild species likely being auditioned for further experimentation and manipulation, [for] those showing the most promise’.

In fact, as the regional case studies have shown, it seems more likely that in many instances foragers were attempting to *preserve* their way of life at a time of stress, rather than deliberately seeking to *transform* it. As Rowley-Conwy (1998: 201) commented in the case of the European Mesolithic, ‘we know that agriculture was to appear [1,000 years later]. They didn’t’. Moreover, as well as not having hindsight, prehistoric foragers certainly did not share in our post-Enlightenment perspectives on their world (Chapter 2, p. 58), our ‘inclusive ideology of the human mastery or appropriation of nature, whose roots lie deep in the traditions of Western thought’ (Ingold, 1994: 11). That being so, what can we discern from the distant perspective of our own world of global markets, industrial agriculture, and GM foods, about why most prehistoric foragers in time became farmers? In this final section I identify a series of underpinning themes all of which I believe have to be taken into account in any general theorizing about the agriculture revolution in prehistory.

Domestication, Commensalism, and Mutualism

Most studies of domestication tend to assume that it has to be explained by unique attributes of human behaviour, but it is important to note that many animal species are characterized by ‘commensal’ or ‘mutualistic’ interactions

between animals that in some cases have similarities to the animal and plant relationships represented in human husbandry (T. P. O'Connor, 1997). 'As far as plants are concerned, we're just one of thousands of animal species that unconsciously "domesticate" plants' (Diamond, 1997: 115). Examples of husbandry-like relationships include fruit bats propagating the seeds of the trees they feed on, and some species of fish guarding succulent algae on coral reefs. Mutualism is a relationship that benefits both species involved in the relationship, commensalism is where one species benefits without advantages or disadvantages for the other. The association of the house sparrow, mice, and rats with human habitation is an example of commensalism, though if rats bring disease the relation is one of 'contramensalism', where the interaction is to the benefit of one and the detriment of the other. An example of mutualism would be the birds that pick parasites off animals like cattle and crocodiles in Africa. The frequency of both commensal and mutualistic relationships confirms the gain in fitness they bring to the species involved. Domestication involved the development of a set of relationships between humans, plants, and animals, in which the interaction was either to the benefit of both species (mutualistic), or because it was beneficial to one and neutral to the other (commensal). Most such relationships were mutualistic. 'People did not take sheep into domestication: rather, people and sheep entered into a particular interaction by behavioural adaptation on the part of both species. The new relationship succeeded precisely because it benefited both species' (O'Connor, 1997: 152). The extraordinary success of the wheats and barleys, out-competing indigenous flora in the large areas of the globe to which they have been introduced, and sustaining a large portion of the world's human population in the process, is a prime example of species mutualism.

Human history has many examples, though, of domestication processes that have not worked for both sides in the same way, and have failed the test of time. Examples we have encountered in the archaeological record have included gazelle in South-West Asia (Chapter 4), floodplain weeds in North America (Chapter 7), and Barbary sheep in North Africa (Chapter 8). The ancient Egyptians appear to have tamed wild animals including gazelle and other antelope, ostrich, monkeys, and possibly leopard (Fig. 10.1). Ostrich, red deer, and musk ox are all examples of wild animals that are now being farmed successfully, in the sense of being successfully bred and managed in captivity, and other recent domestication projects have targeted the elk, moose, zebra, and bison, though it is too soon to tell whether there are long-term prospects of genuine mutualism and of the development of the kind of acceptance of human presence that is a feature of normal farmyard stock (Fig. 10.2). The behavioural effects of domestication have also been studied in



Fig. 10.1. A relief carving from Kalabsha, Nubia, showing the taming of wild animals including gazelle and other antelope, ostrich, monkeys, and a big cat, perhaps a leopard (Phillipson, 1985: fig. 6.11; illustration kindly provided by David Phillipson)

experiments with the fox, Norway rat, Mongolian gerbil, mink, and farmed fish (Arbuckle, 2005). The principal domesticates of modern agriculture have a number of common characteristics making their domestication understandable, a point to which I return later, but at the same time it is important that we do not automatically assume that domestication was something in which humans can only ever have engaged in with respect to the crops and livestock of the modern agricultural landscape.

Scale and Process

The evidence for husbandry probably being practised by some groups of prehistoric Australians (Chapter 6, p. 227), on the one hand, and the reindeer hunting/herding behaviours of Lapps in Greenland (Chapter 2, p. 68), on the other, emphasizes how the web of transformations called the transition to farming cannot be assumed to be geographically circumscribed. Furthermore, as Chapter 2 described, the recent and present-day ethnographic record of foragers and farmers is characterized by a spectrum of activities, with hunting and gathering at one end and intensive farming at the other, rather than by a clear-cut division between foragers and farmers. There is a similar spectrum between highly mobile and sedentary societies, and between very low-density and high-density population levels. These three spectra broadly match, with



Fig. 10.2. (*Above*) the dominant stag of a 'semi-wild' red deer herd on the Scottish island of Rhum; (*below*) feeding the deer at a Scottish red deer farm (photographs: Graeme Barker)



highly mobile/low-density foragers at one end and sedentary/high-density farmers at the other, but there are important exceptions, such as the marine-based foragers who are sedentary and high-density. Furthermore, there are many examples in the historical period of people shifting their location on the foraging-farming spectrum in response to changing opportunities or threats (Mace, 1993).

So what is the chronological scale encompassed by the ‘agricultural revolution’? The answer to the question ‘how far back does farming go?’ depends of course on what particular activity or activities along a long and complicated spectrum of potential behaviours we choose to define as the beginnings of farming (or agriculture, herding, horticulture, and husbandry). In terms of modern biological definitions of domestication, the key threshold is when the plant or animal cannot survive and produce offspring in the wild, but as the archaeological record considered in this book makes clear, focusing on this alone would take out of consideration a huge range of novel relationships between humans, animals, and plants that have to be understood within any holistic model of forager–farmer transitions. In many evolutionary models of plant cultivation, the decision to prepare ground and plant crops, as well as to tend and harvest the latter, is seen as a defining moment (Fig. 1.11), though there are examples of foragers doing both (Australian Aborigines with wild yams, for example). In the case of animals, Zeder (2005: 142–3) proposes that the critical threshold was not so much when managed herds were isolated genetically from wild populations, but when humans started to intervene deliberately and systematically in the life cycle of target species, manipulating herd structures in order to promote herd propagation. As Layton *et al.* (1991: 257) commented, however, ‘at some point along a continuum of movement into intensive husbandry it may be possible to say that cultivation [or herding] has begun, but we regard undue attention to this point as an error associated with the concept of evolutionary stages’.

In one sense, husbandry is as old as the history of *Homo sapiens sapiens*. Burning the landscape to enhance food supplies is certainly as old as the first modern humans who reached South-East Asia (at least) 45,000 years ago, and possibly as old as 100,000 years in Africa on the evidence of Klasies River Mouth, though all the other indicators of modern human behaviour are not observed in the African archaeological record until about 55,000 years ago. It would appear that, pretty much from the outset, modern humans were thinking about their environment and their place within it, and putting their mark on the landscape, in very different ways from earlier species such as *Homo erectus* and Neanderthals. Even on a minimalist interpretation of the evidence for ‘landscape intervention’, ‘domestication was accompanied by a

prior empirical environmental consciousness' (Yen, 1993: 93). And the process of domestication goes on today, of people as well as red deer and musk ox. Many rainforest foraging groups in South-East Asia and South America are being encouraged (and sometimes forced) by governments to settle down and take up farming. I am reminded of the provocative but perceptive comment by Higgs and Jarman over thirty years ago (1972: 13) that 'domestication can be regarded as a long-term process whose limit at one end is defined by the present day, and at the other only by the earliest date that anyone has yet had the temerity to propose'. It remains true, of course, that the extreme and abrupt fluctuations in climate and weather patterns in the later Pleistocene, compounded by the low levels in atmospheric CO₂ affecting photosynthesis, would have made intensive plant horticulture a very difficult and risky affair (Richerson *et al.*, 2001), but clearly from soon after the Last Glacial Maximum technologies *were* developed for plant exploitation, and used intensively as far as we can tell, in regions such as South-West Asia, North Africa, and East Asia, and in South-East Asia intensive tuber exploitation involving aspects of horticulture may be much older still.

At the same time, though, to return to the comments made at the beginning of this section, there was no inexorable path to agriculture, no unstoppable progress along an evolutionary spectrum from low-input mobile foraging to intensive sedentary farming. Hunting-and-horticulture and hunting-and-herding did not lead automatically to agriculture. The archaeological record has in fact examples of societies that 'reverted' to less intensive modes of subsistence, such as the late Natufians compared with the early Natufians in South-West Asia, and the return to hunting by people in the Libyan Sahara after their experiments with herding Barbary sheep; and it must be likely that we shall discover more examples as regional data sets expand and chronologies improve. As Spriggs (1996: 534) commented, subsistence systems incorporating animal and/or plant husbandry 'could well have been widespread in appropriate environmental contexts in the late Pleistocene and early Holocene in many parts of the world, and had no necessary trajectory in the direction of agriculture in any particular case'. Nevertheless, whilst forms of resource exploitation and management that shared some of the characteristics of animal and plant husbandry were clearly being practised by our species in the Pleistocene, it seems only to have been at the boundary of the last glacial/interglacial cycle 20,000–10,000 years ago that factors converged in such a way as to stimulate some societies to develop modes of behaviour recognizably closer to our modern definitions of food production and farming. This is the focus of the next section.

Climatic Change, Sedentism, and Population Growth

At the global scale, a key driver of subsistence change was clearly climatic change, however uncomfortably that fits with the post-modern tendency to privilege individual human agency and to discount other factors shaping human decision-making as crude functionalism or environmental determinism. Certainly seed-plant cultivation in mid-latitudes, difficult or impossible in the markedly unstable climates, widespread aridity, and low levels of photosynthesis of the later Pleistocene, was favoured by the more stable and wetter climates of the Holocene and the enhanced levels of photosynthesis (Richerson *et al.*, 2001). The profound climatic changes between the Last Glacial Maximum and the transition to the Holocene (Fig. 4.5) presented the world's population with enormous challenges and opportunities (Mithen, 2003). In some instances people had little choice, as in the case of their retreat from much of northern Europe and the Sahara in the peak conditions of cold and aridity 20,000 years ago. The same was true for people living in many coastal regions in South-East Asia, confronted by the post-LGM flooding of the Sunda shelf. The same climatic trend in the early Holocene, though, allowed people to move back into the Sahara as it developed into a landscape of lakes, rivers, and grasslands. In northern Europe some reindeer hunters followed the retreating herds northwards as the glaciers contracted after the LGM, others developed new forms of subsistence adapted to the Boreal forests. In many parts of the world, foraging societies were forced to respond to significant changes in the distributions, densities, and predictability of various animal and plant resources generated by the climatic oscillations identified in Europe as the Bølling–Allerød interstadial, the Younger Dryas stadial, and the early Holocene. Only some of their responses, however, were characterized by changes in behaviour that turned out to have far-reaching and irreversible implications in terms of intensifications in systems of food production.

Sedentism, the business of settling down and maintaining significant habitations in one location for many months or years, has been consistently identified as a critical change in the behaviour of many societies in the late Pleistocene and early Holocene. Accordingly, there has been much debate about whether it was the cause or consequence of early agriculture. Bruce Smith (1995a), for example, concluded the former: that the regions where the first agriculture began such as the Levantine corridor, the Sahel, and the eastern Woodlands of North America (for he argued that the first agriculture was based on seed plants rather than root crops or animals, though this thesis is not supported by the evidence of taro cultivation at Kuk in New Guinea and Barbary sheep herding at Uan Afuda in the Sahara) were all places characterized by rich aquatic habitats and the wild progenitors of

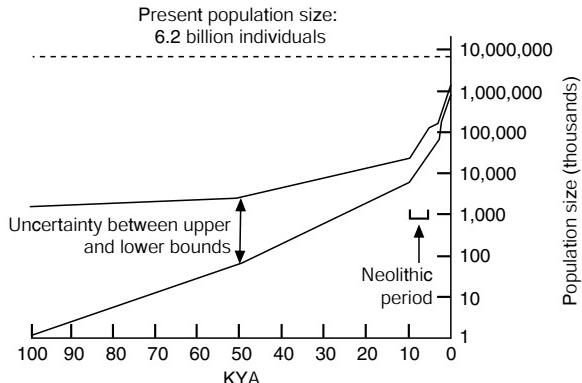
future domesticates. This rich food supply meant that people were already living in 'relatively large, permanent communities occupied throughout most if not all of the year . . . a sedentary way of life, supported by the plentiful resources of an aquatic zone, seems to have been an important element in early experiments with domestication' (Smith, 1995a: 210, 213).

As the archaeological record reviewed in Chapters 4–9 shows, however, sedentism could be both 'cause' and 'consequence' of farming, and neither. The intensive exploitation of rich marine and/or lacustrine and riverine resources certainly sustained many more-or-less sedentary foraging communities in the early Holocene, for example in parts of north-west Europe, the Nile valley, Japan, the Ganga valley, the eastern Woodlands, and coastal Peru, amongst whom agriculture developed later. Equally, sedentism was normally associated with the development of the first major commitment to the use of domestic plants and/or animals as staple foods, as in the case of Near Eastern PPNB villages. However, there are many instances of foraging societies becoming more sedentary, and of foraging societies becoming less sedentary, in either case without developing any involvement with agriculture; and there are other examples of similar trajectories 'into' and 'out of' sedentism that coincided with an involvement with plant and/or animal husbandry. Many 'early agricultural' societies in fact combined foraging and herding, or foraging and small-scale horticulture, or mixtures of all three, and were mobile, in some cases (as in parts of north-west Europe) much more so than when they had been 'pure' foragers.

Population growth has been the focus of similar debates about whether it was the consequence or cause of agriculture (Chapter 1, p. 32). One view has been that population growth followed the beginnings of farming: the use of domesticates meant more food, and more reliable food supply, thus enabling human populations to grow. The opposing view has been that growth in population, stimulated by other factors, forced people to become farmers, because rising populations meant the necessity for more efficient means of food production if starvation was to be avoided. An example of the former is the theory that sedentism developed in the eastern Woodlands in response to improvements in the availability of food sources, and that the consequent changes in annual resource scheduling were an important stimulus of floodplain weed agriculture. An example of the latter is the theory proposed for South-West Asia that the early Holocene climate promoted an expansion in plant and animal resources, which stimulated human population growth, which in turn promoted sedentism, increased territoriality, and subsistence intensification resulting in agriculture.

The fact that, at the global scale, population levels rose dramatically with the transition from the Pleistocene to the Holocene is not in doubt, nor

Fig. 10.3. Global population estimates over the past 100,000 years (KYA—thousands of years ago); a zone of plausible upper and lower bounds is shown on a logarithmic scale; uncertainty in population size estimates is greater in the more distant past (after Jobling *et al.*, 2004: fig. 10.5)



that a general correlation can be observed between the ensuing rise in global populations through the Holocene and the development of societies based on agriculture and then urbanism (Hassan, 1999; Pennington, 1996; Fig. 10.3). What also seems to be indisputable is a common link between sedentism and population growth, though as we have seen above, sedentism was not necessarily correlated with farming. However, beyond reflecting on the possible implications of general models of population growth like Figure 10.3, it is frustratingly difficult to plot the rate and scale of population growth, far less changes in age structures, at temporal and spatial scales that would be useful for advancing the debate about population increase as cause or consequence of agriculture. The problem with such arguments is that the archaeological datasets and chronologies of any particular region are such that it is impossible to reconstruct demographic and subsistence changes (to say nothing of changes in local environments and in the wider cultural systems in which subsistence behaviour was embedded) with anything like sufficient precision to enable a robust examination of their potential interrelationships. The result is that most scholars in recent years have tended to shy away from the role of demographic change in transitions to farming, though Binford (1998) has attempted to model this in the case of Europe, concluding that Holocene foragers there had to undergo organizational changes (variously taking the form of complex forager societies or forager-farmers) once their numbers climbed above a ‘packing threshold’ of about nine people per 100 square kilometres.

The context for population growth in the early Holocene might have been the slight relaxation of controls on fertility that sedentism made possible (Hassan, 1999), but a straightforward causal link between sedentism and higher fertility is unlikely. There is skeletal evidence that some early farmers

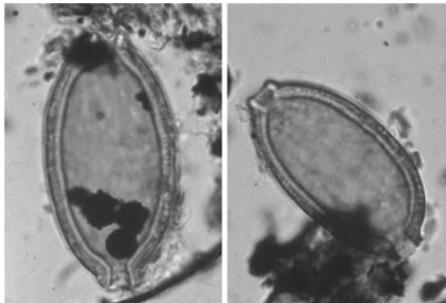


Fig. 10.4. Eggs of the intestinal parasite *Trichuris* (whipworm), their size indicating that they are from humans rather than ruminants, found in pre-agricultural sediments at Goldcliff, South Wales; their presence implies that Mesolithic foragers had become infested through ingesting food or water contaminated by game (after Dark, 2004: fig. 1, illustrations kindly provided by Petra Dark)

were less well nourished than their forager predecessors (e.g. M. N. Cohen, 1995), but also that others were better nourished (e.g. Wood *et al.*, 1992). Human, animal, and plant diseases are generally assumed to have been more problematical once people and domesticates lived together in close proximity (Diamond, 1997; Roberts and Cox, 2003). Health must have been context-specific, though. According to Hassan (1999: 695–6), factors likely to have influenced health and mortality in the early Holocene included ‘crowding, contact with “strangers” in trading communities, division of labour between the sexes and gender status, social hierarchy and differential access to high quality food, health care, differences in workload and exposure—all are clearly factors that came in the wake of agriculture’; but in the preceding chapters we have also come across examples of every one of those factors in foraging communities. The whipworm (*Trichuris trichiura* L.), for example, one of the most common human intestinal parasites worldwide, has been found in coprolites from a number of early agricultural sites in Europe (as well as in the Iceman’s gut), and as it is commonly passed to humans from domestic livestock, especially pigs, an association has been assumed with the beginnings of stock-keeping. However, *Trichuris* eggs have now been reported from water-logged sediments dated to the Late Mesolithic in Wales, of a size indicative of human hosts, suggesting that foragers could also have been infected by ingesting food or water contaminated by the game they were hunting, in this case red deer, roe deer, and wild boar (Dark, 2004; Fig. 10.4).

Climatic Change and Diet Breadth

The returns offered by various food sources with respect to the amount of energy invested in procuring them is an important determinant of subsistence scheduling by foragers today (Chapter 2). The acquisition of the horse by the plains Indians of North America dramatically reduced game pursuit times, for

example, allowing them to reduce diet breadth and concentrate on hunting buffalo, a process further stimulated by the acquisition of firearms. Guns and snowmobiles have had similar effects on Inuit hunting in recent decades. Resources ranked highly by foragers such as larger game animals are easy to process but are generally distributed in clumps in time and space, whereas lower-ranked resources are generally those that are abundant, localized, and predictable, but time-consuming to process, such as many plants (Hawkes *et al.*, 1982; Winterhalder and Smith, 1981; Chapter 2, pp. 50–51). If higher-ranked foods decline in abundance, foragers will do better to invest less time in searching for them and concentrate more on lower-ranked foods, though sustainable yield will be as important as the net rate of return (Winterhalder and Goland, 1993). The development of a reliance on plant husbandry involved just such a concentration on lower-ranked foods (Barlow, 2002). This observation has led to an alternative view of the convergence of sedentism, population growth, and agriculture amongst some societies at the Pleistocene–early Holocene boundary: that the critical factor was a change in diet breadth in response to climatic change.

In the case of South-West Asia, for example, a frequent argument has been that climatic change at the Pleistocene–Holocene boundary would have made higher-ranked resources less abundant, thus decreasing foraging return rates, and would at the same time have encouraged the abundance of plants such as cereals, that would have been low-ranked resources but ones with a high rate of increase or recovery rate under predation. Diversifying the breadth of the diet would have meant shorter search times, allowing smaller foraging territories from campsites and greater investments in storage and food processing, promoting residential stability and population increase and setting in train processes leading to agriculture. Similar arguments have been developed for other regions of the world such as East Asia, North Africa, and the arid and semi-arid regions of the Americas. In Europe, Japan, and the more temperate regions of North America, by contrast, the response by early Holocene foragers commonly was resource diversification, but their resources (smaller animals, fish, and a wide range of plants) were generally unpredictable in time and space, so poorly suited to domestication. In the tropics, the growth of dense rainforest in the early Holocene favoured an increased reliance on low-ranked and low-density resources such as forest tubers and squashes, but this could well have depressed population levels (Piperno and Pearsall, 1998).

Whilst changes in diet breadth at the Pleistocene–Holocene boundary are in no sense a catch-all explanation for the more precocious instances of plant husbandry around the world (animal husbandry, it should be said, has been little considered in the debates about changes in diet breadth), it is certainly true that, in mid-latitude regions especially, the dramatic climatic shifts of the

late Pleistocene and early Holocene often increased pressure on the exploitation of higher-ranked resources and increased the benefits of investing more effort in husbanding lower-ranked resources such as the cereals. On the other hand, foraging societies faced with the same trends in their food supplies responded in markedly dissimilar ways, making general models of diet breadth response to explain the earliest Holocene agricultural systems of limited applicability. More generally, the regional studies show that a transforming event in the long-lived process of forager-farmer transitions was often changes to the availability of certain foods brought about by the social or natural modification of environment, though again, the record emphasizes the variety of human responses to such challenges.

Pre-Adaptations of Plants, Animals, and Places

A common thread running through the search for general explanations for the beginnings of farming has been that particular plants and animals were naturally suited to domestication, and particular places to be the ideal theatres for domestication. The first point was touched on in my earlier comments on Domestication, Commensalism, and Mutualism. The argument is that certain species were long recognized by humans as useful food sources and were exploited by them, and were used to being predated on by humans, for long periods before domestication, so there were few barriers to their domestication. Many of the cereals and legumes, for example, were self-pollinating, were edible without needing processing to remove toxins, gave high yields, could be easily harvested, were suitable for storing, and required little genetic change to develop properties essential for developed horticulture such as quick germination rates and tough stalks. Of the c.150 big (over 100 pounds) terrestrial herbivorous animals, only 10 per cent are recognized as successful domestications: sheep, goat, cow, pig, horse, Arabian camel, Bactrian camel, llama, alpaca, donkey, reindeer, water buffalo, yak, Mithan cow, and Bali cow. All these animals have turned out to be successful at living with humans, and being managed by them, in terms of their diet, growth rates, mating habits, disposition, and social organizations (Diamond, 1997: 168–74). In particular, the wild ancestors of all these animals, as well as the dog, were herd animals rather than species living as isolated breeding groups and solitary individuals, so they were accustomed to the internal social dynamics of the herd, in which humans could replace lead animals in dominance hierarchies.

B. D. Smith (1995a) coined the somewhat inelegant term ‘domestilocalities’ for places where, at particular moments in time, natural and cultural factors clustered together in combinations that made them likely places for

agriculture to develop. In this respect he pointed to the similarities between the contexts in which plant cultivation began in the Levantine corridor, the Sahel, and the eastern Woodlands. All were characterized by lakes and rivers and sustained sedentary communities based on the resources of these rich aquatic habitats. All, though, were to some extent circumscribed by the presence of other societies in surrounding environmental zones that were poorer in resources. Furthermore, in the critical periods of interest (different in the three regions), the environmental gradients between the rich waterside habitats and outlying drier zones were being steepened by climatic change. He therefore concluded that agriculture was developed in these three 'domesticocalities', though at different times, in rather comparable circumstances: 'an agricultural way of life appears to have emerged where societies were not immediately threatened, but nonetheless were encouraged by surrounding circumstances to search widely for ways of reducing long-term risks. One strategy would have been to experiment with ways of increasing the yield and reliability of promising species' (Smith, 1995a: 211).

As an extension of these theories of geographical pre-adaptation, Diamond (1997) has argued that the different axes of the continents of Eurasia, Africa, and the Americas (Fig. 10.5) help explain their different courses of agricultural dispersal. The east–west axis of Eurasia meant that localities distributed east and west of each other frequently share fundamental similarities in annual weather patterns, vegetation types, diseases, and so on, facilitating the rapid

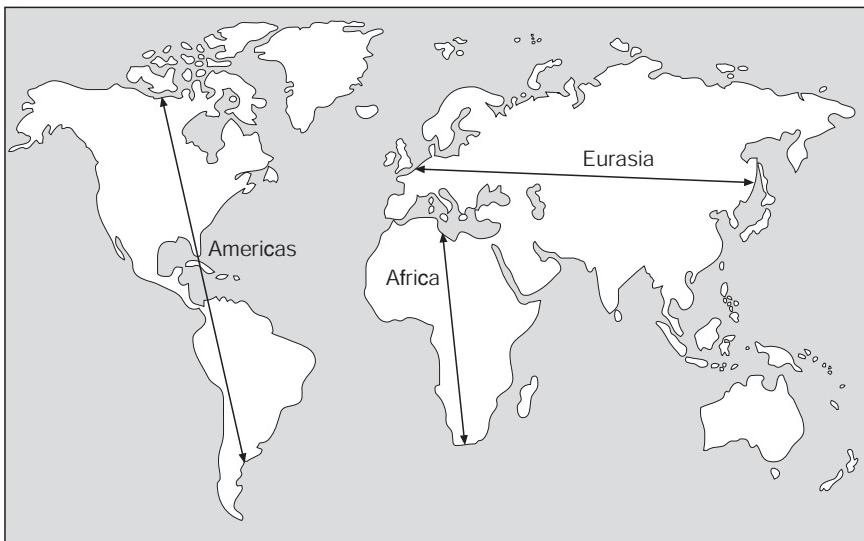


Fig. 10.5. Major axes of the continents (after Diamond, 1997: fig. 10.1)

dispersal of domestic plants and animals. In contrast, the north–south axes of Africa and the Americas presented significant ecological barriers that had to be overcome for crops and animals from one region to thrive in another, barriers that help explain time lapses in the expansion of domesticates and their failure to penetrate particular regions. Though I would take issue with Diamond's acceptance of the case for Neolithic colonists moving west and east from South-West Asia, the different axes of the three continents provide a simple geographical framework that is useful for understanding the different rates of spread of the domesticates into familiar or unfamiliar ecologies from their source regions.

In terms of arguments for pre-adaptations for agriculture, there is certainly a core truth in the suitability for domestication of those plants and animals that have proved to be the mainstays of modern agriculture, and the importance of the zones in which they may have clustered, though the inadequacy of our knowledge of the latter has been emphasized on several occasions. Also, this focus should not take attention away from the evidence of other ancient domestication experiments, like the Barbary sheep in the Sahara, and more importantly perhaps the wide range of husbandry practices or husbandry-like involvement with plant and animal resources that we have observed in the regional studies, such as the long history of forest management and cultivation of forest products prior to the availability of rice in South-East Asia.

Food as Culture

The concept of ranking in food sources dealt with earlier introduces the next major theme underpinning the agricultural revolution, which is that the consumption of food is not just about meeting dietary needs but is also one of the most critical arenas for social relations (Hather and Gosden, 1999): as Sherratt (1991: 222) commented, 'people don't eat species, they eat meals'. In every regional study, we have come across instances of an explosive dispersal of a package of domesticates (and often pottery and other new technologies) over a wide region, on the one hand, but within that region the piecemeal and partial adoption and small-scale use of the domesticates and/or other parts of the package alongside existing modes of foraging. Such examples strongly suggest that the acquisition of domesticates by foragers was frequently driven by social factors rather than dietary needs. Foods that we regard now as staples—wheat, sorghum, rice, maize, cattle, sheep, and so on—must often have been attractive to foragers in the phases of initial contact with farmers precisely because they were exotic, their acquisition bringing prestige and status to the owner. The primary importance of livestock for many foragers

could have been their suitability to be kept as wealth on the hoof, for exchange or consumption in displays of hospitality (Dietler and Hayden, 2001; Hayden, 1990, 1995).

Although Hayden has focused in particular on the possible importance of the domesticates as exotic foods for competitive feasting, we can also envisage them being used as markers of identity and status and to cement social relations in other ways, for example as bridewealth or in community celebrations. Furthermore, although the link between cereals and particular types of pottery has generally been discussed in terms of pottery's utility for grain storage and cooking, in many instances the acquisition of pottery and cereals as a duo could have been as much to do with brewing and the consumption of cereal-based alcoholic drinks, again as a key element of important social and ritual occasions. There could be a similar association between pottery, milk, and milk products (Copley *et al.*, 2003), and perhaps blood as well. As J. Thomas (2003: 72) has commented on the piecemeal acquisition of the Neolithic package in Britain: 'it may be right to imagine communities "buying in" to a new way of doing things, rather than simply adding new material forms to an existing way of life'.

In some instances, no doubt, the new crops and animals would have been treated in much the same way as the food acquired by hunting and gathering. Whatever their roles, there is a common acculturation sequence in many regions in which a long period of small-scale use of domesticates was followed by a very rapid transformation in subsistence (within one or two generations, often) as these foragers committed to being farmers. At this stage the domesticates must certainly have become staple foods, though still being a medium of social display, with hunting often being retained as a high-status male activity. The widespread evidence for a sudden commitment to agriculture following on from a long period of partial use of parts of the agricultural package cannot be explained by any single factor. The involvement with plant cultivation has commonly been regarded as a major stimulus to a trajectory to full-scale farming, with cultivation an 'all or nothing' activity because of the year-round pressure on working the land and tending the crops. However, it is clear that many forager-farmer societies in the central and west Mediterranean and in north-west Europe somehow successfully combined small-scale cultivation with foraging and herding for many centuries, sometimes for well over a thousand years, before they eventually committed to becoming farmers.

An evocative example of the cultural context of food consumption, and of how farming and foraging and their respective social norms and world-views can be integrated even amongst present-day traditional societies, is provided by the Kelabit of the interior highlands of Sarawak, Borneo (Janowski, 2003). The Kelabit engage in wet-rice agriculture, and attach much status to its

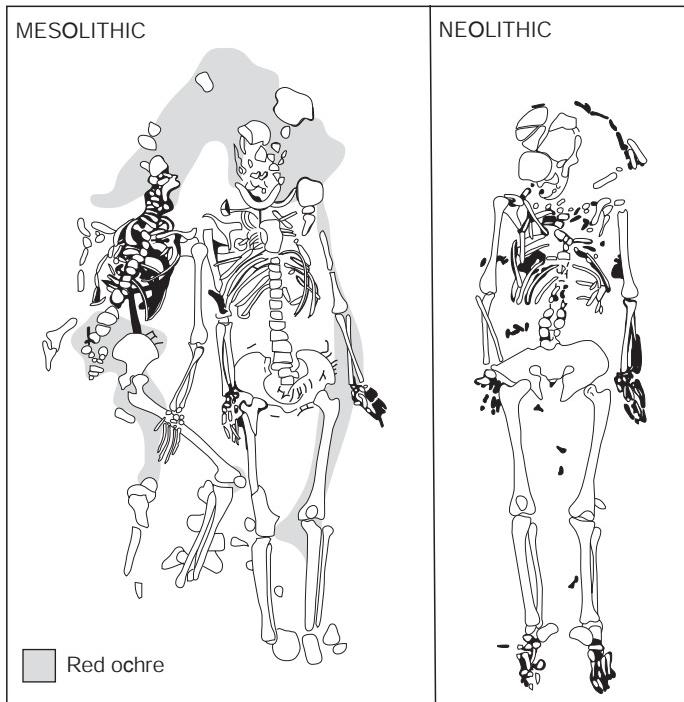
successful cultivation, regarding rice as the means by which proper human life, *ulun*, is made possible. However, they also make extensive use of wild foods, over 80 per cent of their meat, for example, coming from wild animals. The term used for wild foods is *mulun sebulang*, ‘things that grow on their own’, and is used to refer both to forest plants and animals and also to domesticated plants and animals other than rice, because everything except rice is capable of growing without human help, whereas their rice has to be cultivated to survive. Communities live together as groups of extended families or ‘hearth groups’ in longhouses. Gathering of wild foods such as plants and fungi is mainly a female activity, undertaken in the ‘little forest’, the partially cleared areas around the settlements. Women tend to avoid the ‘big’ or main forest, the domain of spirits and where the dead are placed, apart from passing through it on well-trodden paths, whereas the men range widely in both kinds of forest to hunt for pig, various kinds of deer, and a variety of small game.

Alongside the beliefs and rites of Christianity acquired in recent decades, the Kelabit have animistic belief systems: the natural environment and all plants and animals are imbued with *lalud*, a wild, life-giving, but potentially dangerous force, which is controlled especially by killing game in the forest and killing domestic pigs, and consuming the meat. Rice is the major status marker for Kelabit communities and the social focus of the day is the rice meal, with each family eating only rice produced by its hearth or household group, whereas side dishes of wild foods are shared with neighbours. ‘Rice, the rice meal, and the hearth at which it was cooked, epitomized human control; the forest and all that was in it epitomized both a vital resource which was the basis of human life, and lack of human control’ (Janowski, 2003: 57). In always eating rice with foods that are wild or treated as wild, and in the social practices in which food is consumed, the Kelabit combine household and community-wide sharing systems of food consumption, in traditional models the respective domains of foraging and farming societies (Chapter 2). At the same time, the combination of rice and wild foods brings the domesticated domain together with the wild life force *lalud* and so makes proper human kinship, *ulun*, possible.

Subsistence and Ideology

At Dragsholm in Denmark there was a burial of two Ertebølle forager women, accompanied by a decorated bone dagger, a bone awl, pendants made from wild boar and red deer teeth, beads of cattle and elk teeth, and red ochre (Fig. 10.6). Isotope analysis shows that they had a marine-dominated diet. Some three centuries later, a man was buried nearby accompanied by items

Fig. 10.6. Mesolithic and Neolithic burials at Dragsholm, Denmark (after Brinch Petersen, 1974, and R. Bradley, 1993: fig. 7)



of Neolithic material culture: a pot, a stone axe, a stone battle-axe, ten flint arrowheads, and amber pendants. His diet was based on terrestrial foods. The grave-goods in the women's grave, like those of the woman buried at Vedbaek (Fig. 9.7), are all of organic materials from the animal kingdom, slightly transformed so as to serve as body ornaments but embedded nonetheless in notions of continuity between humans and animals. The man's artefacts are all of materials quarried from the earth, transformed by technologies so as to be unrecognizable compared with the parent material, their forms redolent of male-focused status tied to aggression. 'They were two metres apart in space and less than three centuries apart in time, but the people who were buried there had lived in quite different worlds' (R. Bradley, 1993: 35). Graves such as this could once be explained simply in terms of population replacement: Mesolithic foragers were replaced by Neolithic farmers, who brought with them new technologies, ideologies, lifeways, and language (proto-Indo-European). The realization that the man at Dragsholm was almost certainly a descendant of the women buried beside him emphasizes the profound transformations in *mentalités* that took place as communities beginning to combine plant and/or animal husbandry with foraging were drawn into profoundly

different ties to the land, to their collective past (whether real or fictive), and to one other. 'The Neolithic was above all transformational, in that it had to be *performed* ... each element changed in the way people did things' (J. Thomas, 2003: 72, author's italics). If, as is easy to imagine, the 'performance' of these new identities and behaviours associated with the acquisition of agricultural practices involved speaking as well as doing, perhaps this could help account for the wealth of agricultural terms identified by linguistic scholars in the early forms of the language families such as Indo-European, Afroasiatic, Bantu, and Austronesian, without having to have recourse to farmer migrations.

For present-day foragers, as I described in Chapter 2, the food quest is very far from being a matter of efficiently extracting resources from a hostile wilderness. They typically operate in an animate, feeling, benign, and articulate nature that is full of 'kinfolk', the plants and animals they seek. The search involves skilled and attentive engagement with non-human animals in a relationship of trust, not domination (Ingold, 1994; Tapper, 1994). The foraging way of life is as much a mode of spirituality as a mode of subsistence. 'Hunters don't worship gods, they converse with local, earth- and sea-bound spirit persons without adoring them. They are animists, not theists' (C. L. Martin, 1993: 41). Most foragers do not speculate anxiously about the place of the dead, whereas non-Western farming societies are commonly characterized by cults of fertility (of land and people, the former sometimes involving calendrical rituals), and of ancestors, because their farming economy emphasizes the family, the reproduction of the social group, and kinship as an ideology.

The archaeological record indicates that many early farmers, such as those of PPNB villages in South-West Asia, or many Neolithic communities in Europe, were characterized by comparable notions of life and death, fertility and sexuality (both female reproduction and male virility), and ancestor cults typical of many non-Western farming communities (Hodder, 1990, 2001). Little if any of this can be identified amongst prehistoric foraging societies, except perhaps in the case of a few complex sedentary groups, especially ones in contact with farmers. For many forager societies, therefore, the development of farming appears to have marked a shift from a spirituality of myths, totemism, and animism to a very different kind of spirituality characterized by a separation from and distrust of nature (Martin, 1993). Early agricultural societies commonly developed a cosmology of 'sky gods' quite alien to foragers, in order to cope with 'the anxiety over cosmic disorder that seems to lie at the core of all the agrarian religions' (Martin, 1993: 145). God's command to Man in Genesis 1: 28 to 'be fruitful and multiply, and fill the earth and subdue it; and have dominion over the fish of the sea and over the birds of the air and over every living thing that moves upon the earth' stems from

an agricultural and pastoral ethic amongst Old Testament societies in South-West Asia that is entirely alien to the foragers' view of the giving environment and their place within it.

Jacques Cauvin (2000) argued that this kind of agricultural theism first emerged in the PPNA of South-West Asia, whereas farming only developed in the PPNB (Chapter 4, p. 147). Hence he concluded that (for reasons he does not really explore) changes in ideology preceded and drove the transformation of these societies from foragers to farmers. However, as discussed in Chapter 4, the first indications of husbandry-like behaviour in South-West Asia clearly go back much earlier than the PPNA, suggesting that behavioural changes stimulated shifts in foragers' spirituality, rather than the other way round. In the valley of Oaxaca in Central America, too, ideologies characterized by rituals focused on celestial observations developed in tandem with maize farming and village-based settlement, rather than preceding them (Marcus and Flannery, 2004). For Hodder (1990), the long process of domestication was as much about people taming their fears of the dangers associated with death, reproduction, and sexuality as about them taming nature, though such fears were presumably created in the first place by foragers engaging in behaviours that shifted them further along the spectrum towards husbandry. At Lepenski Vir, the 'human-fish' boulders resonant of beliefs of metamorphosis between humans and fishes significantly coincide with the time when this long-lived fishing community was coming into contact with domesticated animals and plants, presumably as traditional concepts of animality were being explored in new ways. In short, I find it easier to envisage new concepts such as sky-god theism developing in tandem with, and integrally related to, all the other cultural and economic transformations involved in foragers becoming farmers, rather than privileging these undoubtedly profound changes in ideology and world-view over all other potential 'causal factors' for the beginnings of farming. The intellectual tools for creating new concepts of spirituality were in place with the emergence of modern humans, but as far as I can tell there is no evidence for the development of concepts of theism until the terminal Pleistocene, alongside all the other cultural transformations presaging the fully developed agriculture of the PPNB and its equivalents elsewhere.

FINAL REMARKS

The development of the commitment to farming by prehistoric foragers has most commonly been explained by changes in food supply linked variously to environmental change (whether naturally or humanly induced), population growth, sedentism, increasingly competitive social relations, or changing

ideologies. Given present understanding it is tempting, as many scholars have done in recent years, to put a little bit of everything into the pot, along the lines of: 'first, take your suitable resource zones; add some diet breadth, including a good sprinkling of long-utilized species well suited to being domesticated; spice with a little sedentism and population growth; stir well with social competition and new identities and ideologies; and bring to the boil with a little climatic change.' However, as Bruce Smith (1995a: 214) concluded at the end of his own perceptive review, 'it is important not to carry the search for similarities too far, or to invest it with too much explanatory authority. The danger is that in rendering down long and complex developmental histories of different regions into a simple set of shared characteristics, we may lose sight of the rich diversity that exists between the various centers of origin'. In this study, too, I have endeavoured to bring out the extraordinary diversity of the evidence, and its geographical and chronological scale, rather than argue for a simple thesis that, however deceptively attractive, fails to acknowledge that diversity. In particular I have tried to demonstrate that such diversity is poorly served by simplistic notions of 'experiment', 'invention', 'migration', 'dispersal', 'acculturation', and so on, however seductive and pleasingly straightforward such schemes might seem. This diversity sits uncomfortably with any attempt to build a grand cross-continental theory of universal applicability for why foragers became farmers. At the same time, however, there are cross-regional similarities and common themes that are not adequately served by simply privileging historical contingency, the uniqueness of each time and place, and the freedom of all the individual human actors involved. As Steve Mithen commented at the end of *After the Ice*, his monumental global human history from 20,000 BC to 5000 BC: 'while the history of each continent was unique ... some forces of historical change were common to all. Global warming was one. Human population growth was another ... [requiring] new forms of society and economy irrespective of environmental change. A third common factor was species identity' (Mithen, 2003: 505–6).

In a global model looking at the implications of climatic change for diet change within a long-term evolutionary perspective, Layton *et al.* (1991) suggested that the demography of Pleistocene foragers would have conformed to the typical pattern of non-human predators, whose numbers typically fluctuate in distinct cycles in response to the changing abundances of prey species. When high-ranked resources are abundant, the predator population increases, leading to over-exploitation and declining rates of return, and to a greater concentration on lower-ranked resources. With the reduction in predation efficiency the predator population declines from malnutrition and increased mortality (especially of infants), thus allowing the high-ranked resources to recover, and the cycle to begin again. In this light, they argued, the

development of seed agriculture amongst several groups of mid-latitude foragers at the beginning of the Holocene could be regarded in many respects as a special outcome of what had been essentially a cyclical process of shifts between high-ranked and low-ranked resources of enormous longevity.

In that case, though, why had agriculture developed at the particular time it did and not, say, much earlier? The answer, Layton (1999) suggested, was a particular combination of climatic change and social evolution. Profound climatic changes with their contingent changes to ecology would have had the propensity to destabilize the stabilizing effects of long-term demographic cycles, encouraging the divergence of populations pursuing alternative strategies including, for some, the specialized exploitation of seeds and roots in periods of aridity. The evolution of robust Australopithecines in the context of the development of arid and open environments 2.5 million years ago was an example of just such a specialized adaptation to low-quality plant foods. The critical difference between pre-modern and modern humans was the ability of the latter (through changes in the brain and the development of language) to make complex social relationships. The appropriate niche for the specialized exploitation of wild grasses may not have arisen since the emergence of modern humans, until the development of early Holocene climates. Hence, Layton concluded (1999: 114), ‘the appearance of farming about 10,000 years ago is thus argued to be the consequence of a chance coincidence of events, in which a species with novel forms of behaviour first encounters a rare climatic event’.

In many respects my own conclusion chimes with this, given the two trends that I have observed in this review. The first is the widespread evidence for modern humans in the Pleistocene, in every kind of environment, demonstrating examples of surprisingly ‘interventionist’ relationships to the landscapes they inhabited that in one form or another presaged the later relationships that we recognize as agriculture. The second is the evidence that probably many more societies than commonly envisaged, in all parts of the world, started to engage in different kinds of animal and/or plant husbandry at or soon after the transition to the Holocene—in South-West Asia, South Asia, East Asia, Island South-East Asia, several parts of the Americas, and North Africa (and who knows when in tropical West Africa?). Independent of one another (at the regional scale, that is), and in many different ways, very many societies arrived at solutions to living in the transformed landscapes they were encountering which we can recognize as the beginnings of systematic husbandry.

The scale and universality of these two phenomena must not be exaggerated, however. For example, it is surely significant that, however ‘environmentally interventionist’ some Pleistocene foragers were, there is no trace of the transformed world-views represented by Neolithic theism in Palaeolithic

culture, and much evidence for the continuation of animistic relations to nature, most obviously in cave art and artefact decoration. Within all the regions mentioned above, many societies arrived at very different solutions to living with the early Holocene that did not involve husbandry, just as they did in Europe until they started to encounter and make use of the Eurasian domesticates. At the Pleistocene–Holocene boundary the really critical factor in the emergence of farming was the same human intellect that in the previous 40,000–50,000 years had taken modern human foragers throughout most of the world: '[people] shared the same biological drives and the means to achieve them—a mix of cooperation and competition, sharing and selfishness, virtue and violence. All possessed a peculiar type of mind, one with insatiable curiosity and new-found creativity... Without it, there would have been no human history but merely a continuous cycle of the adaptation and readaptation to environmental change that had begun several million years ago when our genus first evolved. Instead, all of these factors [global warming, population rise, human creativity] combined, engaging with each continent's unique conditions and a succession of historical contingencies and events' (Mithen, 2003: 505–6).

In arguing against the notion of agriculture having spread by the large-scale movements of farmers, the last thing I would want to imply is that prehistoric societies, foragers or farmers, were somehow fixed in place. Far from it, in fact: the propensity of modern humans to move, at times very rapidly, is another defining aspect of the history of our species (of our 'insatiable curiosity and new-found creativity' in Mithen's phrase). It is quite clear that late Pleistocene and early Holocene foragers were capable of moving considerable distances fast, including crossing challenging physical barriers, whether colonizing Eurasia from Africa, making sea crossings to Australasia and (as seems increasingly likely) to North America, colonizing most of the Americas with astonishing speed, maintaining contacts over thousand of years between the Japanese islands and the Chinese mainland and between Britain and continental Europe, and making regular visits to the Mediterranean islands from adjacent mainlands. The same propensity to move location must surely have been a characteristic of many forager-farmer and farmer societies too. The forager and farmer worlds were equally open to the rapid exchange of information and material goods. Current genetic research, for example, suggests that some of the millets may have been first domesticated in China and then spread (presumably exchanged from group to group) westwards to reach Europe a couple of thousand years later (H. Hunt and M. Jones, *pers. comm.*). For me, a major problem with the demic diffusion model (Bellwood, 2004; Diamond, 1997) of agriculture has been its focus on the transition to farming as some kind of unique sequence of movements in an otherwise static world.

The complex demographic histories implied by the genetic evidence for each major region of the world suggest the same kind of ‘messy complexity’ that I have suggested we can detect in the archaeological record whereby foragers became farmers in different ways and at different rates and for different reasons, but often in comparable circumstances of challenges to the world they knew.

The transition from foraging to farming was the most profound revolution in human history, albeit one whose origins in many respects go back to the beginnings of our species and whose aftershocks have continued in some parts of the world almost to the modern era. Its legacy today is the mechanized and industrialized systems of farming that sustain extraordinary densities of population and a global economy that together threaten the sustainability of our planet on a scale unmatched at any time in the past. It was indeed a revolution, but one that was as much about human imagination and psychology as economic and social behaviour. Alongside transformations in humans’ relationships with animals and plants, and with each other, foragers’ animistic notions of the world as an unconditionally giving parent were commonly transformed (sometimes very suddenly as at Dragsholm, sometimes over many millennia) into a new theism. That theism usually appears to have involved new concepts of human destiny being in the lap of the gods, of sexuality being a threatening force, and of land as something to be controlled and pacified, an ancestor which only gave its wealth in return for favours rendered. In many respects the cosmologies that developed in tandem with, and that underpinned, the development of agriculture amongst prehistoric foragers were the forerunners of the agrarian-based Graeco-Roman, Judaeo-Christian-Muslim, and eastern religions of our own world, all of which have asserted the primacy of humans over the natural world, a primacy that is proving increasingly dangerous to sustain.

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Index

Page numbers in italics refer to illustrations and photographs. The pottery has been indexed alphabetically, not chronologically.

- Abeja 232, 265
Abejas 20, 251
Abelmoschus esculentus 282
Abeurador 336
Abingdon 373
Aborigines, Australia 60, 62
 art systems 98
 farming 227–8
 foragers 61, 75, 396
 rock art 304
 totemic systems 59
 use of fire 65, 71
Abu Darbein 274, 305
Abu Hureyra 40, 105, 121, 138
 abandonment 128
 basketry impressions 139
 gazelle hunting 122, 123
 plant remains 118, 120, 125, 126
 pottery 144
 wild plant exploitation 36
Acanthaceae 208
Acanthosicyos horridus 319
acculturation 38, 328, 390, 406, 411
 Atlantic seaboard 368
 Europe 327, 381; Baltic region 364;
 Britain 370; LBK sites 361;
 Scandinavia 364
Aceramic Neolithic 21, 131, 159
 village 22
Aché 43, 52, 57
Achilleion 326, 348
achira 264, 265, 266, 267
acorns
 Americas: *Guilà Naquitz* 252; Icehouse Bottom 239; South-West 247
 East and South-East Asia: Hemudu 197;
 Torihama 202, 202
 Europe: Greece 346; LBK 363
 South-West Asia 110, 120
Acrocomia palm kernels 262
Adam 150, 175
Adamgargh 150, 168
adaptation, hunter-gatherer 39
addax 98
aDNA, *see* DNA, ancient
Adrar Bous 274, 299, 309
Adrar des Iforas 275
Adriatic Sea 349
adzes 45
 Africa: Esh Shaheinab 306; Shum Laka 311
 East and South-East Asia: Diaotonghuan 191; Hemudu 197; Kuk 220
 Europe: Alpine region 76; LBK 358, 359;
 Star Carr 338
 South Asia: Mehrgarh 162
 South-West Asia: PPNA 132
Aegilops sp. 115
Aegilops squarrosa 160
Aesculus turbinata 202
Aetokremnos 105
afforestation 262: *see also* forest(s)
Afghanistan 11, 106, 151, 154, 156,
 385
Africa(n) 273–324, 389–90
 cattle: breeds 164; domesticated 96, 98,
 281, 323; Egypt 291–3; Sahara 291–4,
 300, 309; Sahel 309, 389; wild 289,
 291, 294, 300
 continental axis 404, 405
 crops 281
 farming 78: rainforest 310–14;
 traditional 276–8
 fieldwork, difficulties 40
 foragers 42, 283–8, 413: *see also* !Kung
 San Bushmen
 languages 167, 279, 279
 millets 156, 173
 plant impressions 82
 rice 277, 282, 310
 root crops 25
 sites 274
 sub-Saharan 102
 urban civilizations 2

- Africa(n) (*cont.*)
see also Central Africa; East Africa;
 North Africa; South Africa; West
 Africa; and under names of individual
 countries and regions
- Afrikaans mythology 324
- Afroasiatic
- farmers 321
 - languages 279, 279, 280, 321, 409
 - pastoralists 272–324
- After the Ice* 411
- afterlife 293
- Afyeh 274
- Agadez 313
- Agave 237
- agave cactus 252, 388
- age
- determination: animal 89; human 93
 - difference 358
 - structures 400
- Age of Herding 9
- Age of Hunting 6
- Age of Pastoralism 6
- agency 40, 398
- Agerød 326, 339
- Aggersund 326, 343
- agouti 241
- Agouti pacá* 241
- agricultural
- colonists 356
 - colonization model 335
 - domestication 35
 - prehistory 221
 - theism 410
 - tools 193, 220
 - villages 157
 - workers 171
- Agricultural Origins and Dispersals* 16
- agriculture 65
- definition 2
 - Neolithic 13
 - spread of, models 278–83
 - traditional, Africa 276–8
- see also* crop(s); farming; plant cultivation
- agro-pastoralism 234, 346, 367, 378, 379, 381, 390
- Agta 43
- Aguadulce 232, 258, 259
- Ahar 150, 174
- Aikio, Pekka 68
- ‘Ain Ghazal 105, 137, 140, 143
- ‘Ain Mallaha 22, 105, 118, 119, 125, 126, 129
- Ainu 43, 201
- Air 275
- Aisne valley 360
- Aizoon canariense* 299
- Ajalpan 20
- phase 251
 - aji 234, 264
- Ajuereado phase 251
- Akā 43
- Akjoujt 313
- Alayawara 52
- Albanian language 101
- albatross 201
- alcohol 264, 388, 406: *see also* beer; brewing; fermentation
- Aldenhovener plateau 326, 360
- algae 79, 393
- Algeria 275, 299
- Ali Kosh 20, 21, 105, 137
- Ali Tappeh 150, 154
- Alice Boer 240
- aliens 383
- Aligrama 150, 175, 176
- Allenrolfera occidentalis* 53
- Allerød interstadial, *see* Bølling-Allerød interstadial
- alligators 197
- alluvial landscapes 348
- Almeria 352
- almonds 110, 113, 115, 134, 136, 336, 346
- Alocasia denudata* 208
- Alouatta palliata* 241
- alpaca 22, 31, 234, 403
- Alps 92, 334, 337, 345
- Alpine region 76, 364
- Als 326, 367
- Altamira, Spain 45
- altered states of consciousness 304
- alveolar absorption 170
- amaranth seeds 251
- amaranthus 242
- Amazon 257
- basin 233, 262, 263
 - lowlands 233, 269
- amber 203, 366, 366
- pendants 408
- ambush locations 237
- Star Carr 338

- Amekni 274, 299
American Bottom 232
American South-West 24, 293
 farming 246–8
Americas 78, 232, 388
 continental axis 404, 405
 diversification 402
 farming 231–72
 foragers 311, 413
 husbandry 412
 maize 307
 North-West 34
 tribes 61
 urban civilizations 2
 see also American South-West; Central America; Mesoamerica; North America; South America; *and under names of individual countries*
- Amerind languages 99, 236
Ammerman, Albert J. 327, 327
amphibians 259
AMS dates 83, 164, 249, 252, 285, 308, 309
Amygdalus 115
Anacardium occidentale 234
Anaktuvuk pass 66
analogy, ethnographic 74
Ananas comosus 234
Anasazi 248
Anatolia(n)
 plateau 104, 105, 105
 south-central 137, 141
anatomically modern humans 273, 283
ancestor(s) 38, 99, 106, 375
 cults 409
ancestry, concepts of 374
Anchar 175
Andamanese 43
Andarayan 183, 224
Andean lima bean 257
Andean zone 22
Andersson, J. Gunnar 189
Andes 96, 233, 234, 236, 257, 262
 transitions to farming 268–71
Aneibis 274, 305, 306
Angola 280
animality 58
animal(s) 3, 9, 87–92, 223
 bone jewellery 126
domestication 1, 269: pre-adaptation to 403–5
dung 2, 81, 178, 234, 292, 295, 298, 319, 350
extinct 4
footprints 78
Ganga valley 169
husbandry 11, 87, 91, 145, 195, 345
size changes 163
stalling 73, 77, 82, 198
taming 394
 see also under names of individual species
animism 59, 407, 409, 413
Antelope cervicapra 160
antelopes
 Africa: Egypt 393; Elands Bay Cave 288;
 Ghana 312; Sahara 294; Sahel 305;
 Wadi Kubbaniya 286
Americas: American South-West 247;
 Tehuacán valley 237
in art 394
South Asia: Ganga valley 169
Anthemis 292
anthropology 3
antibiotics 57
antler(s) 2, 155, 188, 194, 343, 356
 reindeer 329
staff, pierced 329
Star Carr 338
tools 346
Anyang 183
apartheid 324
Apeget 274
Apennine mountains 78, 337
Appalachian mountains 231
apples, wild 363
apricot 204
Aq Kupruk
 I 156
 II 154
Aqualithic 295
Arabian camel 403
Arachis hypogaea 234, 256, 257, 264
Araracuara 232, 267
Aravalli hills 168
arboriculture 225, 226, 314, 387
archaeobotany 17, 18, 89, 360
archaeological
 science 3, 17–26, 41, 76
 theory 3, 15, 36, 40
archaeozoology 17, 18, 88
Archaic foragers 53
architecture, public 261

- Arctic 56, 145
 tundra 47
Arctium 204
 ards 76, 368
Areca catechu 185
 Arenal 232, 240
 Arene Candide 326, 350
 argali sheep 11, 155, 156
 Argissa 326, 346
 arid
 conditions 22
 regions 60–62, 250
 aridity 398, 412
 Africa 283, 314, 389: Nile valley 289;
 Sahara 300; South 275; Tadrart Acacus
 295, 298
 Americas 242, 252
 Central and South Asia 154, 157
 East and South-East Asia 195, 218
 South-West Asia 128, 129
 Arlit 299
 armadillo 52, 241, 258
 armadillo-like animal 237
 Arnhem Land 62, 71
 aroids 208
 Arremte 43
 arrow(s)/arrowheads 5, 345, 366
 Africa: Fayum 290; Ghana 312; Tadrart
 Acacus 299
 in art 165
 Central and South Asia: Mahasati 168;
 Mehrgarh 162; Van Vagrīs 151
 East and South-East Asia: Hemudu 197;
 Sannai Maruyama 203
 Europe: Friesack 339
 flint 75, 122, 408
 South-West Asia: Kebara 111; PPNB 139
 wounds 287
 arrowroot 257, 258, 262, 266, 388
 art 3, 98, 127
 cave 10, 99, 413
 India 165
 mobiliary 143
 Natufian 129
 systems 73
 Upper Palaeolithic 45
 see also rock art
 artefact(s) 15, 74–6
 construction 17
 see also under names of individual
 artefact types
- Artemesia 187
Artocarpus altilis 226
 Aru Islands 223
 Aryan-Graeco-Italo-Celtic languages 101
 Asfaka 326, 349
 ash 295, 312
 middens 316, 318
 Ash Cave, goosefoot 244
 Asia 42, 78, 335: *see also* Central Asia; East
 Asia; Island South-East Asia; South
 Asia; South-East Asia; South-West
 Asia; and under names of individual
 countries and regions
 Asiab 136, 137
 Asiatic cotton 152
 asphalt 203
 asses 286
 Tadrart Acacus 297
 wild 160
 see also donkeys
 Assam 149, 149
 Atacama desert 87, 232, 269
 Atbara 286, 305
 Atlantic
 Europe 370: foraging 338–46; France
 372; transitions to farming 364–70
 Ocean 13, 231, 233, 241
 phase 334, 338, 340, 351, 359
 region, forager-farmer relations 366, 366
 seaboard 342, 367, 368
 atmospheric CO₂ 397
Atriplex sp. 122
 auks 201
 Aures mountains 299
 aurochs 106
 Africa: Egypt 291; Haua Fteah 283; Wadi
 Kubbaniya 286
 in art 136
 Central Asia 153
 Europe: Denmark 339; Greece 335;
 Netherlands 343; Star Carr 338
 horn cores 287
 Australasia 413
 Australia(n) 206, 210, 394
 Aborigines 59, 60, 61, 62, 65, 71, 98, 396
 desert 56
 farming 227–8
 foragers 42, 52, 69–70, 75, 92, 387
 human occupation 81
 New South Wales 62
 rock art 304

- Australimusa bananas 226
 Australopithecines 412
 Austroasiatic languages 99
 farmers 215
 Austronesian
 colonization 221, 222, 225
 dispersal model 224, 387
 expansion 217
 farmers 218
 languages 102, 167, 217, 409
 availability phase 364, 379
 Avebury 372
 district 373
Avena sterilis 115
 avocado 234, 264
 Cauca valley 263
 domesticated 31
 Pacific coast 267, 268
 seeds 251, 262
 Tehuacán valley 22
 awls 122, 197, 407
 axe(s) 74, 328, 343, 366
 Africa: Esh Shaheinab 306
 Central and South Asia: Mehrgarh 162
 East and South-East Asia: Peiligang 192; New Guinea 220
 Europe 4: Alpine region 76; Italy 75; Star Carr 338
 greenstone 313
 iron 151
 polished 311, 350
 South-West Asia: Jordan 139
 stone 45, 312, 322, 365, 408
 waisted 209, 209
Axis axis 160
 Axum 274
 Ayacucho 232
 basin 22, 236, 268
 Azraq 105, 128
 basin 121, 140
 sites 141
 Aztec empire 233
 Bac Bo 210
 backed blades 155
 Bacon, Francis 57
 Bactrian camel 171, 403
Bactris gasipaes 234, 256, 257
 Badari 274
 badger 334
 Baghor 150
 II 164
 III 155
 Bagor 150, 168, 175
Bagrus 305
 Bagundji 62
 Bahn, Paul 329
 Bahrain 171
 Baijia, tools 193
 Bailey, G. N. 92
 Baka 63
 Bakers Cave 232, 250
 baking 259, 263
 Baktaman 70
 Balakot 150, 167
 balanced reciprocity 46, 366
Balanites aegyptiaca 299
 Balbridie 326, 371, 371, 372
 Balearic Islands 335
 bali 186, 403
 Baliem valley 183, 222
 Balkan(s) 106, 328, 348
 forager-farmer interactions 354
 Neolithic cultures 15
 settlements 361
 southern 356
 tell dwellings 355
 transitions to farming 352–7
 ball courts 248
 Balma Abeurador 326
 Balmi Margineda 326
 Balof 183
 Balsas river valley 232, 254, 258
 Baltic 13, 357
 forager-farmer relations 366, 366
 islands 345
 region 343, 364, 367
 Sea 342
 transitions to farming 364–70
 Balto-Slavic languages 101
 Baluchistan 149, 150, 167
 agricultural villages 165
 bezoar goat 106
 Chalcolithic cultures 153
 Mehrgarh 158, 159, 164
 bambara groundnuts 317
 bamboo 188, 196
 grass 201
 shoots 213
 bamboo rat 190, 212
 Bamenda 274

- Ban Chiang 183, 215, 216
 Ban Kao 215
 caves 213
 Ban Non Wat 183, 215
 burial 216
 Ban Tha Kae 215
 banana(s) 1, 209, 226
 cultivation 185, 220, 221
 Ethiopia 277
 phytoliths 219, 312, 313
 wild 164, 221
 Banbo 183, 199
 band societies 46, 54–5
 banded palm civet 212
 bandicoot 169
Bandicota bengalensis 169
 Bannu 150, 175
 banteng 186
 Bantu 324, 389
 colonist model 322, 324
 expansion 280
 farmers 272–324
 /Khoisan admixture 323
 languages 102, 167, 279, 409
 -speaking people 323
 Banwari Trace 232
 Banyan Cave 212, 213
 barasingha 160
 barbarism 58
 Barbary sheep 283–5, 297, 299, 300
 domestication, failed 393
 herding 397, 398, 405
 horn, tools 295
 hunting 288, 295
 mortality profiles 284
 wild, managing 298, 337, 389
Barbus 305
 Bardagué 274, 299
 Barhval 151
 Baringo 315
 bark-cloth 224
 barley 1, 5, 186, 189, 393
 carbon isotopes 95
 domesticated 11: Africa 278; Ethiopia 310; Maadi 293; Nile valley 276; Wadi Kubbaniya 285: Central and South Asia 152: Burzahom 175; Deccan 178; Harappa 174; Indus valley 172: East and South-East Asia: Yayoi period 204: Eurasian system 108, 149, 383: Europe: Greece 346; LBK 359;
- Portugal 93: South-West Asia 18: Abu Hureyra 140; Azraq sites 141; Iraq ed-Dubb 135; Jarmo 21
 hulled 292, 367
 Indus valley 172
 Franchthi cave 336
 Mediterranean coast 276
 naked 157, 290, 367
 Nile valley 277, 286
 rachis 86
 seasonality 178
 six-row 157, 160, 290, 292, 346, 350
 TRB 367
 two-row 31, 134, 139, 160, 290, 346, 348
 wild 106, 107, 158: Africa: Klasies River Mouth 321; Nile valley 389; North-West 285: Central Asia 153: Europe: Balkans 352; Mediterranean 384: South-West Asia 109, 110: Levantine corridor 120; Mureybit 121; Ohalo II 113, 115; Tell Aswad 134; Zagros region 136
 barns 77
 barnyard grass 202, 203, 204
 barracuda 246
 barriers to colonization, crossing 413
 barrow(s) 372
 cemeteries 245
 see also burial mounds
 barter 1, 17: see also exchange; trade
 basalt 121
 mortar 111
 base camps 47, 48, 62, 116, 252, 295, 330:
 see also camps/campsites;
 encampments
 Bashidang 183, 191, 192
 rice 192
 basket(s) 2, 62, 134, 151, 199, 203
 Africa: Sahara and Sahel 321; Tadrart Acacus 295, 298
 Americas 61, 245
 asphalt-coated 162
 Europe: Alpine region 76; Friesack 339
 impressions 139
 -lined pits 292
 in rock art 303, 304
 South-West Asia: Basta 139; Mehrgarh 160; Ohalo II 112, 114
 bass 339
 Basta 105, 138, 143

- Bat Cave 22, 232, 246, 247, 252
 Batak 43
 Batalimo 274, 312
 Batek 43
 Batek De' 213, 214
 bathing complexes 170–71
bâtons de commandement 329
 bats 207
 battle-axe 408
 Bayat 20
 bead(s) 170, 214, 306
 bone 168
 copper 162
 necklaces 160
 from teeth 407
 bean(s) 31
 Americas 234, 257: American
 – South-West 62, 246; Belize 261;
 – Coxcotlan phase 22; Mesoamerica 36,
 96; North America 242, 249; Pacific
 coast 268; South America 263,
 264
 East and South-East Asia: China 187;
 – Sannai Maruyama 204; Spirit Cave
 212
 Europe: LBK 359
 jack 31: Americas 234, 257; Pacific coast
 267; South America 264, 266
 bears 5, 7
 bearded pig 186, 207
 beaver 65, 114, 241, 334
 bedding 87
 Bedouin 8
 beech 334
 forest 201
 nuts 202
 beefsteak plant 204, 387
 beer 271, 307, 378, 390
 -making 145, 277
 vessels 319
 see also alcohol; brewing; fermentation
 beetle 215
 behaviour 34, 351, 409
 change 398
 behavioural ecology 50
 Behy (Céide) 326
 Beidha 21, 105, 129, 137, 140, 142
 buildings 142, 142
Beilschimiedia sp. 84
 Beishouling 183
 Beixin, tools 193
 Belan valley 150, 155, 164, 169, 176
 rice 170
 Belgium 368
 Belgrade 356, 384
 belief systems 74, 304, 340, 345, 407, 410:
 see also religion; ritual(s)
 Beli-Lena cave 150, 164
 Belize 259, 261
 sites 240
 Bellwood, Peter 102, 217
 expansion model 218
 Belt Cave 150, 155, 156
 Bender, Barbara 34
 Bengal 149
 Bengali language 101
 Berber language 280
 Bering Strait 235
 Berkshire 339
 berries 87, 151, 213, 242, 268, 334,
 350
 betel nut palm 185, 212, 213, 225, 226
 bezoar goats 155, 157
 Bhils 151
 Bhimbetka 150, 165
 rock art 166
 Bhutan 149
 big forest 407
 Big Game phase 302, 303
 big men 383
 bighorn sheep 248
 Binford, Lewis 27, 28, 32, 36, 47, 400
 Bir Kiseiba 274
 birch 338
 bark rolls, Star Carr 338
 Bird's Head peninsula 183, 209, 223
 birds
 Africa: Kadero 306; Tadrart Acacus 297;
 Wadi Kubbaniya 286
 Americas: Bakers Cave 251; Caverna da
 Pedra Pintada 237; Panama 258
 in art 136
 Central and South Asia: Deccan 151;
 Ganga valley 168, 169; Iran 21
 East and South-East Asia: Bashidang
 191; China 187; Nenumbo 225; Niah
 223
 eggs 63
 energetic return rates 52
 Europe: Iron Gates 340
 exotic 173
 migratory 27, 299

- birds (*cont.*)
 mutualism 393
 nests 44, 207
 sea 4, 201
 South-West Asia: Levantine corridor
 120, 125; Ohalo II 112
 see also under names of individual species
 Birhor 43
 Birimi 274, 309
 Bismarck Archipelago 182, 210,
 225
 bison 31, 176, 235, 393
 kill-sites 238
 rock art 329
Bison antiquus 237
Bison priscus 235
 bitter vetch 346
 bitumen 139, 162
 Bjørnholm 326, 365, 366
 black gram 151, 152
 black plum 213
 blackberry 334
 blackbuck 151, 160, 172
 Blackfoot 43
 bladelets 111, 114, 122
 blade(s) 14, 111, 114, 285
 tools 132, 328
 blankets 234
 Blench, Roger 311
 blinds 68
 Blombos Cave 317
 blood 291, 359, 378, 406
 -feuds 56
 ties 59
 blowpipe 258, 260
 darts 208
 Blue Nile 305
 Bluefish Caves 232
 boar 160, 164, 202
 in art 136, 165
 teeth 407
 wild 5: Chulmun sites 199; Eurasia 186;
 Ganga valley 169; Harappa 172; New
 Guinea 64; South-West Asia 110;
 Wales 401
 boats, skin 341
 Boer farmers 324
 bog(s) 78
 bodies 92
 Denmark 79
 sacrifices 367
 bog bean 334
 Bogoria 315
 boiling 331
 Bökönyi, Sandor 33
 Bolan pass 159
 Bolivia 63, 257, 262
 Bølling-Allerød interstadial 117, 117, 118,
 130, 332, 387, 398
 Bombay 149
Bombyx mori 189
 bone(s) 2, 15, 76
 Afghan caves 154, 155
 animal 9, 73, 79, 87–92: *see also under
names of individual species*
 butchered 238
 charring 212
 chemistry 3, 88
 decorated 127
 disease 307
 distribution 90
 human 92–6: *see also burials; skeletons*
 marrow 125
 technology 116
 working 283: Star Carr 338
 bone artefacts 45, 112, 122, 167, 203, 208,
 211, 311
 awl 407
 dagger 407
 combs 366
 fish-hooks 201
 handles 14
 harpoons 289, 294, 300, 305, 306, 312,
 314
 hooks 347
 jewellery: beads 168; earrings 170; rings
 160
 leisters 353
 points 197, 305, 343
 sickle 193
 Boomplaas 274, 317
 Boraginaceae 122, 295
 Boreal
 foraging, Europe 338–46
 forests 398
 phase 338
 borers 139
 Borneo 102, 182, 183, 206, 223, 225
 cattle, wild 186
 ethnographic studies 224
 Kelabit 406–7
 Neolithic colonists 217

- ocean-floor cores 209
 Penan 44, 63, 207
Bos sp., *see* cattle
Bos gaurus 186
Bos indicus 106, 151, 160
Bos javanicus 186
Bos namadicus 153, 160, 164, 172
Bos primigenius 106, 153, 164, 291
Boselaphus tragocamelus 160
 Bosumpra 274
 Botswana 275, 317, 319
 bottle gourds 31
 Americas 234, 242, 244: Central 251, 252, 259; South 263, 266, 267
 Jomon 202, 204
 Thailand 212
 bottleneck, domestication 96
 bottles 127
 boulders, sculpted 340
 Bouqras 105, 137
 bow(s) 151, 165, 201, 339
 and arrow 331
 Bowles 232
 bowls 122
 grinding 133: *see also* mortars
 stone 111, 127, 156, 162
 Boyas 151
 bracelets 126, 160, 162, 214, 306
Brachiaria deflexa 277
Brachiaria ramosa 152, 169, 177, 178
 Braidwood, Robert J. 19, 21, 22, 25
 Brandwijk 368
Brassica campestris 194
 Brazil 257, 262
 highlands 233, 236
 brazil nuts 237
 bread 378
 -making 7
 bread wheat 152, 157, 175, 293, 346, 350, 359, 377
 breadfruit 225, 226
 wild 164
 bream 334
 breeding, plant 86
 Breton cemeteries 344
 brewing 2, 87, 145, 204, 271, 378, 388,
 406: *see also* alcohol; beer;
 fermentation
 bricks 131, 132
 bridewealth 278, 304, 318, 406
 bridles 329, 330
 bristley foxtail millet 150, 152, 176, 177
 Britain 328, 332, 378, 413
 Neolithic houses 371
 Neolithic package 406
 transitions to farming 370–8
 see also under names of individual countries
 Brittany 344, 368
 broad-spectrum
 adaptation 383
 diet 285
 foraging 210, 213, 247, 258, 306, 321, 340, 387
 hunting 197, 262
 hunting and gathering 26, 252
 subsistence 27, 28, 28, 32
 brocket deer 241
 Broederstroom 274, 316, 319
 bronze
 metallurgy 200
 tools 175
 Bronze Age 4, 101
 Early 351
 settlement 15
 Brooks Range, Alaska 66
 broomcorn millet 185, 194, 200
 Brothwell, Don 17
 brown bear, tamed 345
 brown dorcopsis wallaby 209, 223
 browntop millet 150, 152, 176, 177
 brushwood 87
 Brześć Kujawski 326, 360
 Buang Merabak 209, 223
 Bubaline phase 302
Bubalus bubalis 186
Buchanania 178
 buckets 76
 buckwheat 168, 202, 203, 387
 buffalo 165, 235, 305
 hunting 402
 meat 250
 rock art 166, 302
 see also water buffalo
 Bug river 357
 buildings 248
 Beidha 142, 142
 communal 161
 Hemudu 196
 LBK 362
 see also dwellings; houses; huts

- bulbs 65, 83, 294
 Bulgaria 86, 353
 Neolithic house 355
 bull figurines 167
 bulls 141
 skulls 136
 see also cattle
 bulrush millet 150, 277, 281
 Africa 281
 bundling 245
 burdock 202, 204
 burial(s)
 Africa: Sahara 310; Sudan
 306
 areas 191
 Central and South Asia: India 164, 168,
 170, 175; Mehrgarh 162
 collective 374
 customs 143
 dog 245
 East and South-East Asia: Huanghe
 valley 192; Lapita 225; Thailand
 216
 elite 366
 Europe: Denmark 407–8, 408; Greece
 348; Lepenski Vir 356; Mesolithic 343,
 344, 345; Neolithic 377
 flexed 213
 monuments 364, 367
 mounds 4, 6, 371, 374, 375
 ritual 368
 South-West Asia: Natufian 112, 116, 119,
 125, 126, 127, 129; PPNA 132; PPNB
 144
 burins 139
 Burkino Faso 312
 Burma, *see* Myanmar
 burning 61, 71, 227
 Africa 283, 321, 323
 Australia 61, 71, 227
 Europe 342, 345, 354
 New Guinea 209
 South-East Asia 386
 see also swiddening
 burnishers 122
 Burundi 313
 Burzahom 150, 175
 Bus Mordeh 20, 137
 Bushmen 29, 42, 48, 55, 56, 57, 324: *see also*
 !Kung San Bushmen; San Bushmen
 butchery 66, 87, 89, 125, 158, 201
 elephant 305
 butter 151
 churns 76
 butternut squash 212, 234, 257
 Butyrospermum parkii 312
 Buxton 371
 buzzards 112
 Bylany 326, 357, 360
 byres 81, 318
 C3 plants 194
 C4 plants 194, 249
 Cabeço da Arruda 326, 343
 cabins 346
 caching 331
 cacti 237, 252
 fruits 247, 263
 Cactus Hill 232, 236
 cairns, stone 66
 Cairo 384
 Cajanus 178
 Cajanus cajan 152
 Calabria 349
 Calakmul 232
 Calathea allouia 256, 257, 259
 calcium carbonate 82
 calendrical rituals 409
 calibration 109
 Callander 371
 Cambodia 182, 186, 213
 Cambridge palaeoeconomy 33
 camel(s) 31, 171
 herding 277
 pastoralists 277
 rock art 302
 camelids 234, 268, 269
 Cameroon
 banana phytoliths 277, 389
 Bantu languages 102, 280
 people 63
 pottery 312, 313
 region 281
 Shum Laka rock shelter 287,
 311
 camomile 285, 287
 camote 268
 Campalou rock shelter 326, 331
 camps/campsites 71, 402
 Africa: Kenya 315, 316; Nile valley 289;
 Sahel 308; South 288
 Americas: Alaska 66; Great Basin 53;
 Mississippi valley 239, 242; Peru
 263

- Central and South Asia: Ganga valley 168
Europe: TRB 367
field 49
hunting 331, 337
lakeside 339
Mesolithic 342
riverside 241
in rock art 302
seasonal 140, 252, 258, 341
South-West Asia: Kebara 111; Natufian 118, 123
see also base camps; causewayed camps; encampments
Canabis sativa 152
Canada 52, 231
Arctic 49
British Columbia 235, 251
hunting territories 48
Newfoundland 241
Ontario, northern 65
tundra 66
canalization 268
canals 205, 248, 267
irrigation 246
Canarium sp. 209, 223, 389
nuts 212
seeds and nuts 225
Canarium schweinfurthii 311
Canarium zeylanicum 164
Canavalia ensiformis 234, 256, 257
Canavalia plagiisperma 256, 257, 264
Canis sp. 20
Canna edulis 256, 257, 264
cannibalism 345, 367
canoes 201, 343
Cape 276, 277, 288, 322
Horn 231
region 316
Cape York 43, 62
capers 285, 290
capitalism 13
Capparis 122
Capra hircus 106
Capra hircus aegagrus 106, 155
Capra ibex siberica 155
caprines 20
footprints 139
see also goats
Capsicum sp. 264
Capsicum annuum 234, 256, 257
Capsicum baccatum 234, 256, 257
Capsicum frutescens 234, 256, 257
Capsicum pubescens 234, 256, 257
capybara 241
Caquetá 266
valley 265
Carabali 232, 258
Caral 232
carbohydrates 93, 125, 369
carbon 96
isotopes 95, 270
carbonization 87
carding combs 76
Cardium edule 335
Caribbean 16, 257
caribou 66, 235, 237
hunting 241
migration routes 67, 68
see also reindeer
Caribou Inuit 43
Carica papaya 234
Carlston Annis 232, 245
carnelian beads 306
carnivores, Tadrart Acacus 297
carp 197
Carpathian mountains 340, 357
carpentry 75, 139
carrying capacity 27
Cartesian model 58
carts 145
carving
Göbekli Tepe 136
Nubia 394
see also engraving
Case, Humphrey 370
cashews 234
Casma valley 232
Caspian Sea 106, 149, 154
littoral 109, 155
cassava *see* manioc
cassowary 223
Castanopsis 212
castor 152
Çatalhöyük 105, 137, 139, 141, 143, 144
artefacts 347
catfish 286, 287, 289, 305, 353
Catfish Cave 274
cats 31
domesticated 346

- cattle (*cont.*)
 disease 276
 DNA 164
 domesticated 1, 31, 96, 97, 98, 359:
 Africa 281, 323; Egypt 287, 291, 292,
 293; Ethiopia 310; Ghana 312; Sahara
 300, 309; Sahel 309, 389; Central and
 South Asia: India 169; Iran 20;
 Mehrgarh 162, 163, 167; Eurasian
 system 108, 352; Europe 4, 78, 350,
 356, 365, 366, 366; Britain 370, 374,
 375, 378; Denmark 365; Greece 346;
 Iron Gates 340; LBK 363; TRB 367;
 South-East Asia: Ban Chiang 216;
 South-West Asia: Jarmo 21
 dung 81, 178, 319
 figurines 319
 herding 167, 314, 319
 horn cores 88
 importance of 319
 -keepers 310, 376
 milk 57
 modern 164
 mutualism 393
 organization 318
 pastoralism 389
 in rock art 99 100, 303
 size 163
 stalls 77, 82, 176
 teeth 407
 as wealth 390
 wild 106: Africa: Egypt 291, 300; Nile
 valley 289; Sahara 294; Central and
 South Asia 153; Afghanistan 155;
 Ghar-i-Mar 156; India 164, 168, 169,
 169; Mehrgarh 160, 161; East and
 South-East Asia: Vietnam 210;
 Europe: Greece 330; South-West Asia
 110; Çatalhöyük 141; PPNA 135;
 Zagros region 130, 136
 see also under names of individual species
 Cauca valley 232, 233, 263, 265, 266
 causewayed
 camps 367, 371, 372
 enclosures 372, 373, 374, 375
 Cauvin, Jacques 39, 147, 410
 Cavalli-Sforza, Luca 327, 327
 cave(s) 4, 77
 Africa: Libya 283, 295, 296, 299; Sahara
 337
 Americas 253
 art 10, 45, 99, 413: *see also* rock art
 Central and South Asia: Iran 154
 coastal 349
 East and South-East Asia 213, 223:
 China 187, 190, 210; Japan 200
 Europe 335: Dordogne 328, 329; Italy
 331
 painted 331
 sediments 252
 South-West Asia: Levantine corridor
 118; Nahal Hamar 139; Zagros region
 130
 Thailand 188
 see also rock shelters
 cave bear 5
 Caverna da Pedra Pintada 232, 237, 240,
 263
 Çayönü Tepesi 21, 105, 135, 137, 139,
 143
Cebus capucinus 241
 Céide 375, 375
 celestial observations 410
 Celtic languages 101
Celtis 306
Celtis integrifolia 308
 celts 5, 365
 cemeteries 93
 Africa: Nile valley 287, 293
 Australia 227
 barrows 245, 372
 Central and South Asia: Ganga valley
 170; Mehrgarh 160, 162
 East and South-East Asia: Jiangzhai
 199; Jomon 204; Khok Phanom Di
 214; Nishida 203; Yang-shao
 198
 Europe 343, 344: LBK 358; Skatetholm
 345
 Mahadaha, faunal remains 169
 South-West Asia: Natufian 129
 zones 192
 see also burial mounds
Cenchrus biflorus 308
 Central Africa 278
 transitions to farming 314–20
 *see also under names of individual
 countries*
 Central America 18, 231, 232, 235, 240,
 244, 388, 410
 crop plants 256, 257
 domestication 2

- see also under names of individual countries*
- Central Asia 11, 24, 106, 149–64, 385–6:
see also under names of individual countries
- Central Cattle Pattern 318, 318
- cereal(s)
- domesticated: Africa 278, 316, 389; Sahel 309; Central and South Asia 165, 167, 385; Deccan 151; Harappa 171, 177; Hindu Kush 156; Indus valley 172; Europe 368, 374; Britain 370; Greece 348; Ireland 370; South-West Asia: Abu Hureyra 144; Jarmo 21; Levant 146; Natufian 135; PPNB 139, 140
 - fermentation 145, 378, 406
 - grains 9, 223
 - pollen 364
 - pre-adaptation to domestication 403
 - processing 61, 356
 - required rainfall 104
 - wild 19, 27, 29, 31, 106, 111, 117, 118, 128, 134, 353, 384; Central and South Asia: Indus valley 175; South-West Asia 108; Abu Hureyra 122; distribution 107; Natufian 125, 126; Zagros region 130
- see also grains; and under names of individual species*
- ceremonial
- buildings 261
 - centres 265, 372
 - feasting 222, 223
 - monuments 98–9, 245, 371, 374, 391
 - mounds 265
- ceremonialism 99
- ceremonies 406
- Aborigines 59, 70, 227
 - Africa 302, 304, 307, 318
 - Europe 364, 369, 374, 375, 378
 - South-West Asia 141, 143
- see also ritual(s)*
- Cerro Juanaqueña 246
- Cerro Mangote 232
- Cervus canadensis* 235
- Cervus duvauceli* 160
- Chaco Canyon 232, 246, 247, 248
- Chad 275
- Chadic language 280
- Chagylli-depe 150, 157
- Chalcolithic 351, 352, 357
- cultures 153
- Chami 274
- chamois 331, 340
- Chang, T. T. 185
- Channel 370, 371
- charcoal 82, 83, 87
- Fiji 225
 - Panama 239, 259
 - profile, Lake La Yeguada 260
 - Sahara 301
 - South-East Asia 209
 - South-West Asia 111
 - chariots, rock art 302
- charki* 234
- charred
- grain 156
 - rice 224
- Chavín period 268
- cheek-pieces 329
- cheese 78
- making 351, 359
- chemistry 17
- bone 94
 - soil 125
 - see also isotope(s)*
- Chencha 43
- Chenchus 151
- chenopods 110, 122, 187, 234, 243, 244, 250, 292
- Chenopodium album* 168, 334
- Chenopodium berlandieri* 241, 243, 244
- Chenopodium quinoa* 264, 269
- chert hoes 244
- chestnuts 200, 202, 202
- Chevdar 326, 355
- chevrotain 164
- Chiapas 261
- Chibune 274
- chica* 270, 271
- Chichen Itza 232
- chickens, domesticated 31
- Africa 316
 - East and South-East Asia 185, 189, 194, 199, 216, 225, 226
- chickpeas 120, 139, 149, 152, 285, 346
- Indus valley 172
- chiefdoms 46, 233, 246, 267
- chiefs 45, 56
- Chilca 232, 267

- Childe, Gordon 24
ex oriente lux 325, 335, 353, 359
 on foragers 40, 44–6
 oasis hypothesis 9–19
 Chile 233
 coast 236
 mummies 92
 chilli peppers 22, 234, 251, 257, 263
 China
 climate 210
 farming, Asian system 153
 fieldwork, difficulties 25
 foragers 195, 413
 hearth of domestication 2
 loess soils 194
 millet 185, 194, 386, 413
 Neolithic colonists 217, 387
 northern 187, 189
 rice: domesticated 24, 185, 194, 195, 197,
 204; wild 185, 188, 190, 387
 tools 193
 trade 202
 urban civilizations 2
 vegetation 184
 Chinese archaeologists 41
 Chinese cabbage 194, 202
 Chinese dates 194
 Chipewyan bands 66
 chipped stone technology 122
 Chirand 150
 chisel, stone 160
 chital 160
 chitelle 165
 Chopani-Mando 150, 164, 169, 174
 Chorrera 266
 Christ's thorn 115
 Christian era 307
 Christianity 407
 chronological
 framework, Africa 273
 scale 396
 chronologies 400
 chub mackerel 201
 Chukotka 43
 Chulmun culture 199
 subsistence 200
 Chundu 274
Cicer arietinum 152
 circumscription 383
 ciruela 267
 cities, origins 10
Citrullus sp. 306
Citrullus colocynthis 292
 clams 116, 136
 clans 8, 15, 60, 126, 199, 344
Clarias 305
 Clark, Grahame 24
 Clark, J. D. 278, 338
 classification 4
Clausea rosa 265
 clay 45, 118
 baked 131
 discs 197
 fabrics 76
 figurines 143, 348
 fired 21, 82
 impressions of rice 174
 pots 168
 spindle whorl 169
 see also pottery
 clearance
 Africa 276, 311, 317, 389
 Americas 259, 263
 East and South-East Asia 226
 Europe 353, 368
 clematis 81
 clientship 310
 climate change 11, 12, 16, 73, 79, 131, 383,
 397, 404
 Africa 276, 283; East 314; Nile valley 288,
 289; Sahara 321; Sahel 321
 Americas 248, 388; aridity 242; South
 America 262
 Central and South Asia 154
 deterioration 195
 and diet breadth 401–3
 diminution due to 30
 East and South-East Asia 184, 188,
 210
 Europe 332–5
 Greenland ice cores 116, 117
 population growth 32, 398–401
 reconstructing past 17
 Sahara 294
 sedentism 398–401
 and social evolution 412
 South-West Asia 25, 27 109: Fertile
 Crescent 19, 188, 120, 128, 146, 384;
 rainfall increase 135; Zagros region
 130
 trends 389
 vegetational histories 81

- Close, Angela E. 291, 292
cloth 45, 63, 151, 214
fragments 76
see also textiles
Cloudsplitter 232, 243, 244
clover 292
Clovis 232, 236
club wheat 350
club-rush 285, 287, 389
cluster bean 152
coastal
archaeology 210
fisher-gatherers 16
fishing 49
islands 52, 62
locations 16
North America 45, 57
plain 233
populations 27
regions 4, 122
settlements 268
coati 52, 241
Cob Cave 232
Coba 232
cobbles, edge-ground 262
Cobweb Swamp 232, 259
coca 264, 266
leaves 265
cockles 92
shells 335
coconut 63, 185, 225, 226
Cocos nucifera 185
cocoyams 234, 257
cod 341
cognition 38–9
PPNB 143
cognitive behaviour 283
Cohen, Mark 32, 36
Colha 232, 259
collagen 95
collared peccary 52, 241
collecting 48, 49, 55, 62
systems 47
Colocasia esculenta 185, 218
colocynth melon 110
Colombia 71, 233, 236, 257, 262, 263, 265,
266
colonialism 13, 44, 58, 220,
276
European 145
colonists 251
colonization
Africa 310, 320
Americas 235, 388
Australia 81
Central and South Asia 167
East and South-East Asia 209
Eurasia 413
Europe 226, 227, 328, 346, 360
thesis 217
Colonsay 326, 341
combat 70: *see also* violence; warfare
combs, bone 366
commensalism 392–4
common ancestry 59
common beans 234, 251, 257, 258, 266, 267
common millet 150
commoners 56
communal animal drives 298
communication systems 300
maritime 349
community burials 348
competition 383
complex societies 56
Compositae grasses 295
conduits 263
Congo 52
river 311
western 63
-Zaire basin 275
consolidation phase 364, 368, 379
consumption 118, 405, 406
containers 2
continental axes 404–5, 404
contraception 57
contramensalism 393
Cook Islands 227
cooking 406
Africa 290, 291, 305, 322
Americas 249, 250, 263, 271
East and South-East Asia 188, 197, 212
Europe: Bulgaria 86
South-West Asia 134, 144
coots 286
Copan 232, 259
Coppa Nevigatta 326
copper 142, 173, 351
beads 162
metallurgy 167, 177
smelting 313
tools 168, 175
coppicing 87

- coprolites 22, 82, 92, 250, 287, 401
 human 214, 295
 see also dung; faeces
- coral reefs 393
- cord(s)/cordage 203, 226, 234, 247, 295
 -decorated pottery 191
 impressions 197, 212
 markings 187
- Cordia* 178
- Cordilleran ice sheet 235
- Cordilleras 262, 265
- cores, bipolar-flaked 139
- Corfu 349
- cormorants 197, 201
- corms 65, 83
- corn 264
 cobs 22, 31, 249
- Corona 232, 240, 258
- corralling devices 349
- Corsica 335
- cosmologies 59, 409, 414
- Costa Rica 231
- cotton
 Americas 234: Central 251, 257, 258;
 Pacific coast 268; South 257, 265, 266
- Central and South Asia 162, 167, 386:
 Indus valley 172
- Coula edulis* 312
- County Mayo field systems 375, 375
- courtyard 248
- Cow Ford 232
- cow pea 152, 309, 312, 317
- cowrie shells 216
- Coxcotlan 20, 22, 251
 foragers 237
 phase 236
- coyol palm 258
- crab apple 334
- crabs 21, 27, 63, 164, 210, 212, 214
- craft(s) 293
 development 246
 production 167, 226, 254
 specialization 141, 171
 -workers 1, 353
- Cranborne Chase 372
- crane 197
- Crataegus* 115
- Crathes 371, 372
- cream-flowered cranesbill 110
- Cree 52
- cremation 358
- Crete 106
- crib-biting 329
- Crickley Hill 326, 372
- Crimea 384
- Criș
 culture 354
 river 353
- Croatia 337
- crocodiles 258, 289, 292, 294, 305, 393
 in rock art 301, 302
- crocuses 110
- crop(s) 11, 78, 81, 147, 194, 204, 224, 263
 African 281
 farming 195
 fields 2
 growing 316
 husbandry 178, 376
 North America 243
 origins 18
 plants, domestication 256, 257
 processing 87
 residues 139, 157
 rotation 353, 360
 Sahel 277
 South Asia 152
 system, Eurasia 158
 see also agriculture; cultivation;
 farming; plant cultivation; and under
 names of individual species
- cross-dating 15
- Crotalaria bracteata* 213
- croton oil plant 213
- Croton tiglium* 213
- crucifers 110, 122
- crustaceans 242, 334
- Cucumis melo* 152
- cucurbit(s) 2, 84, 243, 252, 264, 316,
 317
- Cucurbita argyrosperma* 234, 256, 257
- Cucurbita ecuadorensis* 256, 257
- Cucurbita ficifolia* 234, 257
- Cucurbita maxima* 234, 256, 257
- Cucurbita mixta* 22
- Cucurbita moschata* 234, 256, 257
- Cucurbita pepo* 234, 241, 256, 257
- Cuello 232, 261
- Cueva de los Ladrones 258, 259
- Cueva de los Vampiros 258
- Cuiya 43
- culling 68, 190
- cult paraphernalia 357

- cultigen 65, 71, 255, 268
cultivars 253, 264
cultivation 13, 14, 42, 44, 136, 221,
 242
 system 76
 see also agriculture; crop(s); farming;
 plant cultivation; *and under names of individual species*
cultivators 12, 14
cultural
 frameworks 15–17
 prehistory 24, 26
 progress 392
 property 55
Cultural Revolution 41
culture concept 15
cuneiform records 171, 173
cup-holes 111, 132, 133
cursuses 374
cuscus 210, 222, 223, 277
cushaw 234
Cushitic language 280
Cuzco 232
Cyamopsis tetragonolobus 152
cycad seeds 63
Cyperus rotundus 285, 286
Cyprinidae 112
Cyprus 137, 335, 346
Cyrenaica 283
 Barbary sheep 284
Cyrene 277
Czech Republic 357, 364
- Dabba, Barbary sheep 284
dagger, bone 407
Daima 274, 309
Daimabad 150, 177
dairying tools 76
Dakawa 274
Dakhlar oasis 274
Dakhlet el Atrous 309
Dalmatia 337, 349, 351
 coast 349
dama gazelle, Tadrart Acacus
 297
damage signatures 76
dambos 316
Damdama 150, 164, 168
 faunal remains 169
dams 61, 248, 343
dancing, in rock art 165, 302
- Danube basin 340, 356, 357
 forager-farmer interactions 354
 transitions to farming 352–7
The Danube in Prehistory 325
Dapenkeng 183
Darfur region 310
Darling basin 62
Darwin, Charles 101
dassie, Tadrart Acacus 297
Dasyprocta punctata 241
Dasyurus novemcinctus 241
dates (fruit) 151, 160, 172, 386
dating
 problems 252
 rock art 302
 see also AMS dates; radiocarbon dates
Dawenkou 183
 tools 193
The Dawn of European Civilization 9, 16,
 325
De Bruin 368
Dead Sea 139
death 410
 masks 143
debt 310
Deccan 150, 151, 175, 177
 arid regions 176
decision-making 35
decoration 300, 413
 landscape markers 343
posts 339
 see also carving; engraving; rock art;
 tattoos
deer 27, 52, 110, 112, 120, 135, 141, 169,
 172, 176, 340, 407
Americas: Andes 268; Ecuador 262; Gulf
 of Mexico 242; Oaxaca 252
antlers 188, 194
Central and South Asia: Deccan 176;
 Ganga valley 169; Harappa 172
East and South-East Asia 185: Bashidang
 191; Gua Cha 213; Jomon 202, 202;
 Vietnam 210
energetic return rates 52
Europe: Iron Gates 340
-hunting camp 337
phalanges 126
South-West Asia 27, 110: Çatalhöyük
 141; Levantine corridor 120; Ohalo II
 112; PPNA 135
 see also under names of individual species

- defleshing 374
 deglaciation 332–5
 Deh Luran plain 20, 21, 26
dehesas 352
 delayed return systems 49, 55, 345
 demic diffusion model 102, 217, 321, 413
 demography 56–7, 92
 histories 414
 PPNB 141
 trends 93
 Denham, Tim 217
 Denmark
 auroch 339
 bog bodies 92
 burial 344, 407–8, 408
 camps 343
 cereals 365
 foragers 340
 Mesolithic 4, 89
 Ordrup Mose bog 79
 sedentism 369
 TRB 367
 dental
 decay 93, 369
 disease 171, 213, 215, 250: abscesses 170,
 171; caries 93, 95, 168, 170, 171, 175
 evidence 263
 see also teeth
 dentalium shell 126
 denticulates 122
 dentition 93
 deoxyribonucleic acid, *see* DNA
 Depression 10
 Descartes, René 57, 58
 desert(s) 60–62
 Australia 52, 56
 basins 248
 cattle 291
 China 184
 Fertile Crescent 12
 foragers 154
 fruits 250
 gravel 275
 immediate return system 49
 South America 233
 South-West Asia 104, 105
 steppe 109, 110, 140
 see also under names of individual deserts
 desertification 299, 383
 desiccation 76, 81, 87, 92, 278, 299, 321,
 389: *see also* aridity
 Dhar Tichitt 274, 308, 309, 309, 310
 Dholavira 150, 170
 Dhonkwa shelter, rock art 166
 Dhra' 105, 132
 Dia 274, 308
 Diamond, Jared 392, 404–5
 Diaotonghuan 183, 187, 190, 191
 diatoms 79
 Dickson Mounds 232, 250
 Didwana salt lake 154
 Die Kelders 274, 317
 diet
 Aborigines 227
 Africa 287
 Americas 261: North 239
 breadth 51, 72, 262, 401–3
 carbohydrates 369
 Central and South Asia: Mehrgarh 161
 change 307, 337, 411
 East and South-East Asia 188: Jomon
 200, 202; Khok Phanom Di 215;
 Thailand 213
 Europe 356: Britain 377, 378; Ireland 377
 fish 242
 gender differences 204
 high in starch 265
 maize 259, 261, 269
 marine foods 342, 407
 meat-dominated 136
 poor 32
 protein 95, 213
 South-West Asia: Çatalhöyük 143;
 Natufian 125, 128
 vegetable 244, 285
 weaning 57
 diet determination
 archaeobotany, use of 87
 bone chemistry, use of 3, 17, 73, 94
 coprolites, use of 92, 287
 dog remains, use of 89
 see also isotope(s)
 diffusion 16, 24, 26, 168, 383
 model 158
 digging 343
 sticks 16, 35, 75, 75, 162, 165, 191, 339,
 368
Digitaria exilis 277
 dikdk 305
 Dilmun 171
 trade 173
 diminution 30, 88, 141, 162

- Dimolit 183
 Dinaric Alps 340
 Dingzhunag 194
Dioscorea alata 84, 85, 185
Dioscorea bulbifera 226
Dioscorea cayanensis 281
Dioscorea esculenta 185
Dioscorea hispida 84
Dioscorea rotundata 281
Dioscorea trifida 234, 256, 257, 259
 dipterocarp rainforest 206
 disarticulation 245
 disease(s) 89, 92, 401, 404
 - anaemia 307
 - animal 87
 - cancer 57
 - and contramensalism 393
 - diabetes 57
 - heart 57
 - infectious 57
 - leprosy 93
 - mitochondrial 98, 164, 323
 - obesity 57
 - osteoarthritis 93, 95
 - osteomyelitis 112
 - osteoporosis 307
 - sleeping sickness 276
 - syphilis 93, 268
 - tuberculosis 378
 - see also* dental diseases
 dispersal 228, 386, 387, 405, 411
 - agricultural 2
 - human 97
 - models 280
 - patterns 3
 display 245
 disposition 403
 dissection 245
 ditch(es) 78, 90, 263
 - around villages 349
 - and palisade earthworks 363
 - ring 373
 diversification 385, 402
 diversity 411
 - linguistic 280
 divine order 57
 Divostin 326, 353
 DNA
 - ancient 3, 73, 86
 - diversity 97
 - evidence 389
 fingerprinting 108
 mitochondrial 98, 164, 323
 modern and ancient 96–8
 patterns 384
 polymorphisms 258
 sheep and goat 156
 studies 3, 293, 386, 387: cattle 299, 304;
 - rice 174, 186
 Dniester river 357
 Doel 326, 368
 dog(s) 4, 31, 403
 - Africa: Kenya 314; Nile valley 293; South 316
 - Americas 234: Belize 261; maize-fed 250
 - bone chemistry 339
 - burials 245
 - Central and South Asia: Iran 20; Mehrgarh 160
 - East and South-East Asia 16, 185: Ban Chiang 216; Bismarck Archipelago 225; China 187, 194, 387; Hemudu 198; Jiangzhai 199; Khok Phanom Di 215; Yang-shao-cun 189
 - Europe 331, 352, 379, 390: Greece 346; Iron Gates 340; Scania 343; Star Carr 338; TRB 367
 - South-West Asia: Çatalhöyük 141; Jarmo 21
 - teeth marks 237
 - use in hunting 51, 63, 387
 dog salmon 201
 dolphins 201, 334
 dom palm 285, 306, 389
 Domestic Mode of Production 46
 domesticability 383
 domesticating the mind 38–9
 domestication 2, 11, 31, 31, 35, 392–4
 - animal 9, 16, 269: *see also under names of individual species*
 - bottleneck 96
 - crop plants 243
 - experiments 394
 - failed 393
 - origins, Sahara 300
 - plant 25: *see also under names of individual species*
 - pre-adaptation to 403–5
 - processes 73
 - scientific measure of 30*The Domestication of Europe* 39

- domestilocalities 403, 404
domus 39
 donkeys 31, 171, 293, 352, 403: *see also*
 asses
 dooryard horticulture, 254–61
 dorcas gazelle, *Tadarart Acacus* 297
Dorcopsis muelleri 209
 doves 62
 dowries 146
Draba sp. 122
Dracontomelon dao 84
 Dragsholm 407–8, 408, 414
 drainage 36, 261
 Dravidian
 languages 167
 rice farmers 385
Drosophilidae 204
 drug(s) 2
 -induced trance 99
 drying 48, 63, 330, 331
 dryland(s) 231, 376
 foraging 246–8
 ducks 197, 286
 Dufuna 274, 308
 dug-out canoes 201, 308
 Star Carr 338
 Dulong 43
 dumplings 307
 Duna 70
 dung 2
 alpaca 234
 cattle 81, 178, 319
 Elands Bay 317
 goat 350
 in pens 292, 295
 llama 234
 rock art 331
 sheep 350: Barbary 298
 Uan Afuda 300
 see also coprolites; faeces;
 manuring
 durum wheat 160, 386
 Dutch colonization 277
 dwellings 14, 128, 157, 245,
 248
 Balkan 355
 Lepenski Vir 341
 PPNB 138
 see also houses; huts
 dyes 45, 121, 151
 Dyrholmen 326, 343
 eagles 112
 ear ornaments 214, 216
 rings 170
 studs, stone 347
 Early Holocene foragers, South Asia
 164–5
 Early Natufian culture 117–28, 146
 earth dams 61
 East Africa(n) 277, 283, 287, 386, 397
 littoral 313
 transitions to farming 314–20
 see also under names of individual
 countries and regions
 East Asia 385, 386–8, 402, 412
 farming 182–230
 sites 183
 see also under names of individual
 countries and regions
 East Timor 210, 223
 Easter Island 182, 217
 Eastern Bantu 323
 Eastern Carolinas 225
 Eastern Ghats 151
Echinochloa sp. 298
Echinochloa crusgalli 202
Echinochloa colona 152, 305
 ecological
 barriers 405
 changes 384
 prehistoric 24
 ecologies 334
 economic
 behaviour 414
 complexity 351
 specialization 345
 economy
 agricultural 60
 PPNB 141
 Ecuador
 Amazon 267
 El Niño 268
 foraging and swiddening 265
 horticulture
 Jivaroan people 59
 maize, domesticated 264
 plants 257, 266
 rainforests 52, 233
 Edmonds, Mark 372
 Edwin Harness mound 232, 244, 249
 eels 339, 343, 369
 effigies 345

- egalitarian society
- eggs 63
 - Trichuris trichiura* 401, 401
- eggshell 300
 - bottles 127
- egret 197
- Egypt(ian) 11, 275, 287, 292, 313
 - language 280
 - mummies 92
 - pharaohs 302
 - scribes 306
 - sites 293
 - tombs 98: paintings 304
 - tubers 286
 - urban civilizations 2
- Ehret, Christopher 281
- einkorn wheat
 - DNA fingerprinting 108
 - domesticated 31: Africa: Nile valley 293: Central and South Asia: Mehrgarh 160: Europe: Greece 346; Italy 350; LBK 359; TRB 367: South-West Asia 106, 135: Abu Hureyra 118 140; Jarmo 21; PPNB 139
 - experimental growing 134
 - wild: Central and South Asia: Jeitun 157, 158: South-West Asia 106, 107, 110: Abu Hureyra 118; Mureybit 121; Turkey 29; Zagros region 136
- El Abra 232, 236, 240
- El Cayude 232
- El Damer 274, 305
- El Kowm 105, 128
- El Niño 268
- El Omari 274, 292
- El Paraiso 232, 267
- El Recreo 232, 263
- El Riego 20
 - phase 251
- El Wad 125, 126
- Elaeis guineensis* 281, 309, 311
- el-Agial oasis 304
- Elands Bay Cave 274, 288, 317
- elaphure 190, 197
- Elbe 329
- elephant(s) 31, 160, 164, 185, 197, 305
 - ivory 306
 - in rock art 301, 302
- Elephas cypriotes* 335
- Eleusine corocana* 152
- elite(s) 171, 254, 261, 319
 - behaviour 351
 - burials 366
 - competition 26
 - power 268, 321
- elk 31, 339, 393
 - effigies 345
 - Star Carr 338
 - teeth 407
- Ellerbek 343
 - sites 365
- elm 334
 - decline 379, 380
 - shoots 81
- Elsloo 326, 357
- emmer wheat
 - DNA fingerprinting 108
 - domesticated 31: Africa: Nile valley 292, 293: Europe: Balkans 353; England 377; Greece 346, 348; Italy 350; LBK 359; TRB 367: Central and South Asia 152: Mehrgarh 160: South-West Asia 106: Abu Hureyra 140; Iraq ed-Dubb 135; Jarmo 21; Levantine corridor 134; PPNB 139
 - wild: Central and South Asia 158: Jeitun 157: South-West Asia 107: Natufian 113; Ohalo II 115
- En Gev I 111
- enamel hypoplasia 93, 170, 250
- encampments 77, 78, 287
 - seasonal 350
 - see also* base camps; camps/campsites
- enclosure(s) 125, 308, 309, 319, 349
 - circular 367
 - stone 123
 - wall 192
 - see also* kites
- endogamy 129
- energetic return rates 52
- energetics 383
- energy 50, 52
- engagement 409
- Engels, Friedrich 54
- England 338–9
 - Cambridgeshire 375
 - Derbyshire, Neolithic house 371
 - Dorchester 372
 - East Anglian fenland 372
 - lowland 375
 - Mesolithic sites 89

- England (*cont.*)
 Neolithic landscapes 373
 resource scheduling 342
 Yorkshire 338–9
- English language 101
- engraving(s) 177
 La Marche 330
 Saharan 301, 301, 302, 303
see also carving; rock art
- Enkwazini 274, 316
- Enlightenment scientists 57
- enseite 277, 282
 Africa 281
 horticulture 310
 wild 287
- Ensete ventricosum* 277
- environment(s) 52, 400
 change 88
 intervention 412
 reconstructing 17, 80
- environmental
 archaeology 26
 change 25, 26, 36, 39, 79, 410: *see also* climate change
 consciousness 397
 determinism 398
see also climate
- epidemics 57
- Epirus 330
- equatorial forest 102
- equids 156, 169: *see also* asses; donkeys; horses
Equus hemionus 160
Equus hyduntinus 330
- Eragrostis tef* 277
- ergs 275
- Erodium* sp. 122
- erosion 79, 225, 226
- Ertebølle 326, 343, 369
 forager women 407–8, 408
 pottery 365
 settlements 345
 sites 342, 365, 366, 367
- Erythroxylum* sp. 264
- Esh Shaheinab 274, 306, 307
- eskers 68
- Eskimo 49
- Eskimo-Aleut 235
 languages 99
- Estancia los Toldos 232
- estuarine sediments 79
- Ethiopia 277, 282, 283, 287, 310
 farmers 316
- ethnic
 groups 316
 types 280
- ethnographers 278
- ethnography(ies) 394
 Aborigines 228
 Africa 281, 288, 323, 324
 dangers of relying on 53–4
 eastern Woodlands 245
 game drives 128
 original affluent societies 72
 Philippines 224
 Renaissance Italy 74
- ethos 57–60
- Etoro farmers 64, 65
- Etton 326, 372
- Eugeissona utilis* 63, 85
- Eugenia cumini* 213
- Eumusa seeded banana 219
- Euphorbiaceae fruit 212
- Euphrates river 11, 19
 alluvium 135
 valley 104, 105, 105, 118, 128, 130
- Eurasia(n) 106, 404, 413
 agro-pastoralism 390
 crop system 158
 farming systems 384, 385
 steppes 96
 system 382
see also under names of individual countries and regions
- Europe(an) 390–91
 animals, *see under names of individual species*
 cave art 10, 45
 central 357–64
 colonialism 220, 276
 colonists 226, 227, 251
 contact 233, 413
 crop systems 83, 87
 demographic change 400
 dispersal 97
 diversification 402
domus 39
 elm decline 379
 farming: origins 15; transitions to 325–81, 346–52; *see also under names of individual species*
 forest clearance 81

- field systems 78
foragers 253, 369
horticulture 399
ice sheets 12
languages 99, 101, 167
LBK skeletons 98
loess soils 194
mainland 370, 371
Mesolithic 14, 75, 92, 239, 392
Neolithic 24, 99; colonization 385
northern 398
north-west 24, 38, 406
plain 365
plants, *see under names of individual species*
population 311
sailing from 235
sites 326
temperate, foraging 338–46
waterlogged sites 76
western 145
see also under names of individual countries and regions
- Evans-Pritchard, Edward E. 277
Evenki 43
evolutionary
 approach 392
 biology 50
 models 396
ex oriente lux 325, 327
excarnation 245
exchange(s)
 ethnographic record 46
 exotic foods 381
 livestock 310, 406
 long-distance 167
 maize 249
 Mediterranean 338, 351
 Natufian 129
 networks 246, 261, 379, 387, 391
 of information 366, 413
 pigs 222, 223
 systems 142, 267, 293, 313
 see also barter; trade
expansion 236, 357, 379
 model 218
 PPNB farming 158
experiment 411
experimental archaeology 125, 134, 195
exploitation 269
Express Train model 102, 217, 223
faba bean 135
Fabaceae 84, 204
fabric 199; *see also* cloth; textiles
faeces 73, 87, 92
 human 22
 see also coprolites; dung
Fairbank 232
falconry 112
fallow deer 110, 111, 114, 120, 123, 135
familiarity 383
families 8; *see also* kinship; marriage
famine 57
Farafra oasis 274, 291
farmer-colonist models 167
farmers 59
 c. 6000–3000 BC 165–70
 Central Asia and North-West India 155–64
 indigenous American 233
 Neolithic 79, 336: Early 101
 pre-Industrial 2
 seagoing 335
 traditional definitions 44–6
 see also farming
farming 1, 14, 316
 Aborigines 227–8
 Africa 78: rainforest 310–14; Sahel 305–10; traditional 276–8
 Americas 231–72: South-West 246–8
 Andes 268–71
 Asian system 153
 communities 70, 310
 definition 2
 dry 261
 East Asia 189–99
 Eurasian system 384, 385
 Europe, origins 15
 forest 182–230
 intensive 259
 invention of 10
 island Melanesia 224–7
 Island South-East Asia 217–24
 maize 24, 249–51, 410
 Mediterranean 352, 356
 millet 170–75, 192, 387
 mixed 13, 32: Central and South Asia 386; Europe 380; Harappa 175; Italy 349; Jeitun 158; Korea 200; Mediterranean 351; Nile valley 293; PPN 131; Serbia 353
 Remote Oceania 224–7

- farming (*cont.*)
 rice 82, 170–75, 194, 204, 214, 310, 387
 root and tuber 226, 231–72
 sedentary 396, 397
 semi-nomadic 13
 sites, early 19
 South-East Asia 182–230
 South-West Asia 27, 82–3, 383: PPNB
 137, 140, 144, 147, 158
 spread of 25
 swidden 194, 259, 267, 360: *see also*
 swiddening
 systems 162
 tools 76
 transitions to 104–48, 199–205: Balkans
 352–7; Baltic 364–70; Britain and
 Ireland 370–8; causes 383; East,
 Central and South Africa 314–20;
 Europe 325–81; Island Melanesia and
 Remote Oceania 224–7; Island
 South-East Asia 217–24; Nile Valley
 288–94; South-East Asia 210–16;
 southern Europe 346–52; why?
 391–414
 villages 386
 weed 231–72
see also agriculture; crop(s); plant
 cultivation; and ‘domesticated’ under
 names of individual species
- farmsteads 249
 Fascism 10
Fascolaria trapezium 167
 Fat hen 334
 fat intake 383
 fauna(l)
 microscopic 73
 sample 90
 see also under names of individual species
- Fayum depression 274, 289, 292
 sites 290
 feasting 383, 406
 Africa 307
 Americas 253
 East and South-East Asia 222, 223
 Europe 367, 372, 374, 381
 South-West Asia 89, 141, 146
 see also ceremonies
- feathers 44
 Federsee lake 340
 Fengate 326, 375
 fenland 372
- fenugreek 110
 fermentation 2, 63, 145, 252, 264, 378: *see*
 also alcohol; beer; brewing
- ferns 213, 389
 rhizomes 285
 ferret 31
 ferret badger 206
 Fertile Crescent 12, 19, 104, 118, 146, 385
 flooding cycles 11
 grasslands 12
 PPNB villages 383
 fertility 400, 409
 fertilizer 234
 Fezzan region 304
Ficus 178, 295
 field(s) 76–8, 261, 360
 parallel 375
 ploughed 175, 176, 357
 systems 78: Neolithic 375
 taro 222
 terrace 227
 walls 375
 fieldwork, difficulties
 Africa 273
 China 25
 figs 134, 346, 352
 figurines 21, 131, 143, 167, 176, 319,
 348
 Fiji pollen diagram 225
 finger millet 150, 152, 277, 283, 316, 317
 Africa 281
 impressions 312
 Finland 68
 fire 65, 126, 218, 220: *see also* burning;
 swiddening
 firearms 402
 fireplaces 133
 fish 91
 Africa: Khartoum 305; Tadrart Acacus
 297, 299; Wadi Kubbaniya 285
 Americas 242: Aguadulce 259; Amazon
 basin 263; Bakers Cave 251; Belize
 261; Ecuador 265; Schultz 250
 Central and South Asia: Ganga valley
 168, 169; Harappa 171; Iran 21
 Danube 340
 East and South-East Asia: China 187;
 Chulmun sites 199; Hemudu 197;
 Jomon 201, 202; Khok Phanom Di
 214; Nenumbo 225; Niah 207, 223;
 Spirit Cave 212; Vietnam 210

- energetic return rates 52
Europe 335, 343
farmed 394
guarding algae 393
jaws 290
ponds 227
South-West Asia 27; Levant 120; Ohalo II 112; Zarzi 116
supplies 45
see also fishing; and under names of individual species
fishing 16, 47
Africa 283; Fayum depression 290; Nile valley 289; Sahara 294, 308; South 288; Tadrart Acacus 295
Americas: eastern Woodlands 245; Pacific coast 267; Panama 258
Australia 62, 63, 65
Central and South Asia: Deccan 151
communities 310, 356
East and South-East Asia: Malay peninsula 213
equipment 300, 312, 343; floats 151; hooks 76, 122, 197, 201, 300, 306, 312; traps 56, 369; *see also* nets
Europe 4: Alpine region 76; Greece 336, 337; Scotland 341; Serbia 353
fisher-gatherers 16
salmon 49
South-West Asia: Kebaran 113; Natufian 129; PPNA 134
see also fish
fitness 393
Flannery, Kent 25, 27, 28, 29, 32, 36, 251
flax 31, 135, 152, 292, 359, 377
fleece 310
flint(s) 5, 15, 122, 170
arrowheads 408
blades 14, 155, 285, 343
flakes 188, 263
microlithic 74; Star Carr 338
mines 367, 371, 377
tools 4, 5, 14, 45, 76, 295
see also stone artefacts
flooding 61, 149, 210, 285, 348, 398
cycles 11; Nile 276–7, 289, 389
diversion channel 177
floodplain plants/weeds 290, 388, 393
agriculture 399
cultivation 239–46
horticulture 321, 389
theory 242
floors 290
plastered 132, 169, 199
stone-paved 168
flora, microscopic 73
flotation 121
techniques 83
flowers 151; *see also under names of individual species*
fluvial sediments 79
flying squirrel 164, 212
fodder 75, 368
foggaras 277
technology 304
Folsom 232, 236
fonio 277
Africa 281
domesticated 282
Fontbrégoua 326, 336
food 45
as culture 405–7
preparation areas 168
processing 48, 118, 402
procurement systems 32
residues, analyses 73
resources 27
sources 55
storage 126, 164
supply 1, 28
see also diet; and under names of individual food types
footprints, caprine 139
forager(s)/foraging 27, 47–54, 161, 221, 312, 379
Aboriginal 61, 75, 396
Africa 42, 413; Kalahari desert 323; Khoi 317; Late Pleistocene, 283–8; Sahara 294–304; Sahel 305–10; San Bushmen 279
Americas 311, 413; Coxcotlan 20, 22, 251; Ecuador 265; North 239–46; Pacific coast 235; Aché, Paraguay 52, 57
Archaic 53
Atlantic 338–46
behaviour 27
broad-spectrum 210, 213, 247, 258, 306, 321, 340, 387
communities 212
desert 154

- forager(s) (*cont.*)
 dryland 246–8
 East Asia 187–8; China 195, 413
 Europe 335–8; Boreal 338–46; Denmark
 340; Ertebølle 407–8, 408;
 Magdalenian 330; pre-LBK 361
 –farmer relations 354, 354, 365, 366, 366
 Gordon Childe on 40, 44–6
 marine-based 267–8, 396
 Mesolithic 337, 363, 408
 mobile 77, 268, 340, 385, 396, 397
 Pleistocene 186, 205–10, 411
 as producers 60–69
 pygmy 63
 rainforest 205–10
 seascapes 335–8
 sedentary 388
 social 33–8
 societies 43; definition 42
 South Asia 164–5
 South-East Asia: Penan 43, 44, 63, 64,
 207, 208
 South-West Asia: Kebaran 109–14, 128;
 Natufian 116–30; Zagros mountains
 130–31; Zarzi 114–16
 strategies 49
 theory 51–3, 51
 traditional definitions 44–6
 transition to farmers, why? 391–414
 tropical 258, 260
 Xinle 200
 Ford, Richard 35
 forensic archaeologists 96
 forest(s) 87, 153, 210, 288, 334, 386, 388
 beech 201
 birds 210, 258
 boreal 237, 239
 Canada 52
 China 182, 184
 clearance 79, 202, 220, 263, 276, 317,
 353, 389
 coniferous 231
 deciduous 187
 economy 241
 equatorial 273, 313
 Europe 332
 expansion 337
 farming 182–230
 game 341
 highland 209
 horticulture 387
 management 209, 221, 312, 352, 405
 manipulation 217
 pine 332, 360
 products 367
 regions 122
 temperate 65–6
 tropical 62–6, 310–14
 tubers 223, 402
see also rainforests; woodlands
 Formative period 252, 253, 265
 sites, plant remains 266
 societies 254
 villages 261, 267
 Formosan languages 102, 217
 fossil, human 207
 fostering 63
 founder crops 139
 fowling 62, 113
 foxes 21, 136, 160, 165, 262, 334
 domesticated 394
 rock art 166
 foxtail millet 31, 150, 152, 185, 194, 200,
 203
 France 337, 351, 364, 369
 acculturation 368
 Alps 345
 cave art 45
 Dordogne 328, 329
 eel fishing 339
 LBK settlement 360
 legumes 336
 Mediterranean 363
 as refugia 328
 Franchthi Cave 326, 335, 336, 337, 348
 Fraser river 251
 freezing 92
 French language 101
 Friesack 326, 339
 frontier zone 366
 fruit bats 393
 fruit fly 204
 fruits
 Africa: Sahara 294
 Americas 237: Texas 250
 Central and South Asia 151, 165
 East and South-East Asia: Malay
 peninsula 213; Niah 208, 223
 Europe 334: Britain 377
 ripening season 115
 South-West Asia: Abu Hureyra 121, 122;
 Levantine corridor 134;

- Mediterranean region 111; Zagros region 130, 136
wild 115, 346
- fuel 2, 120, 234, 269
wood 245
- Fuente Alamo 326, 352
- Fukui Cave 183, 188, 200
- Fulani pastoralists 304
- functionalism 398
- funerals 145, 251
- fungi 87
spores 92
- Funnel-necked Beakers 367
- furnaces 316
- furniture 173
- furrows 263
- furs 366, 366
- Gabon 312, 313
- Galilei, Galileo 57
- game
China 187
drives 125, 128, 130, 237
forest 199
Ganga valley 168
hunting 45, 51; Australia 65; Mehrgarh 160; Tisza valley 354; South-West Asia 140
management 81, 311
tropical forests 241
see also under names of individual species
- //Gana 43
- Ganga valley 149, 155, 174, 385
faunal remains 169
millet and rice farming 170–75
region 175
rice 153, 386
riverine resources 168, 399
Sarai Nahar Rai 164
settlements 170
- Ganges, *see Ganga*
- Ganj Dareh 105, 136, 139
- Ganweriwala 150, 170
- Gara oasis 274
- Garama 304
- Garamantes tribe 304
- gardening, *see horticulture*
- gardens 222, 263, 357, 360
hillslope 220
- Maori 227
- Garrod, Dorothy 110, 116
- garters 126
- gas chromatography 76, 290
- Gatas 326, 352
- gathering 4, 114, 129
in rock art 302
tools 76
- Gatun Lake 259
- gaur 153, 164, 165, 186, 172
- Gautier, Achilles 291
- Gaván 232
- Gaza 108
- gazelle
in art 98, 136, 394
Africa: Farafra oasis 291; Haua Fteah 283; Nabta Playa 290; Nile valley 289; Wadi Kubbaniya 286; Tadrart Acacus 297, 299
- Central and South Asia: Deccan 151; Ganga valley 165; Ghar-i-Mar 156; Harappa 172; Iran 20; Jeitun 158; Kara Kamar I 155; Mehrgarh 160, 161
- South-West Asia 32, 393; Abu Hureyra 122, 122; Iraq 140; Kebaran 111; Levant 109; Natufian 120, 123, 125, 126, 128, 384; Ohalo II 112; PPNA 134, 135; Rosh Horesha 121; Zagros region 130
see also under names of individual species
- Gebel Akhdar mountain 283
- geese 286
- Geleen 326, 357
- gender
determination, human 93
differences 204, 344–5; health 250
roles 14, 45, 53, 129; Çatalhöyük 144; eastern Woodlands 245; Italy 351; Khok Phanom Di 215; Peru 271
status 401
- gene pool 42
- generalized reciprocity 54
- genetic
changes 36, 195, 403
data 378, 391
diversity 3, 18, 328
finger-printing 96
mutation 236
research 86, 254, 413, 414
- geniuses 383
- geochemistry 79
- geographical pre-adaptation 404

- geometric
 microliths 74, 111, 114, 139, 153, 162,
 164, 165, 168
 stamps 224
 geophytes 283
 Germa 274, 304
 Germanic languages 101
 Germany 360, 361, 364
 LBK sites 362
 plain 339
 rise of Fascism 10
 uplands 329
 germination rates 403
 Ghagharia rock shelter 150, 164, 165
 Ghana 309, 312
 Ghar-i-Asp 150, 154, 155
 Ghar-i-Khar 105, 116
 Ghar-i-Mar 150, 156, 159
 Gheo-Shih 252
 Ghormangar shelter, rock art 166
 giant broomrapes 110
 giant ground sloth 237
 giant peccaries 237
 giant squirrel 164
 gibbons 212, 213
 Gibraltar 384
 Gidjingali 70, 71
 Gifford-Gonzalez, Diane 314
 gift-giving 223, 278, 304, 307
 Gilf Kebir 274, 275
 Gilgal 105, 132
 giraffes 301, 305
 in rock art 302, 303
 Gitxsan Witsuwit'en 43
 glaciers 27, 206, 235, 328
 melting 16
 global
 economy 414
 population 400: estimates 400
 temperature rise 1, 2, 131: *see also*
 climate change
Glossina sp. 276
 glottochronology 101, 236
 glumes 169
Glycyrrhiza 122
 goanna 61
 goat(s) 1, 5, 91, 403
 in art 329
 domesticated 31, 96, 106: Africa: East
 277, 278, 314; Esh Shaheinab 306;
 Fayum 293; Ghana 312; Haua Fteah
 284; Kerma 310; Nile valley 292;
 Nkang 313; Sahara 300; Sahel 281;
 Tadrart Acacus 299: Central and
 South Asia: Bagor 168; Balakot 167;
 Deccan 176; Ghar-i-Mar 156;
 Harappa 171; Iran 20; Jeitun 158;
 Mehrgarh 161, 161, 162, 163: Europe:
 Almeria 352; Balearic Islands 335;
 Balkans 353; Britain and Ireland 370;
 Greece 346, 348; Italy 350: South-West
 Asia 108, 383: Azraq 141; Levant 140;
 PPNB 145; Zagros region 139, 146
 horn cores 88, 156
 size changes 163
 skulls 310
 stall 82
 wild 11, 30, 31, 106: Central and South
 Asia: India 155; Jeitun 157; Mehrgarh
 160: Europe 336: South-West Asia 27,
 384: Beidha 129; Ganj Dareh 137;
 Ghar-i-Khar 116; India 153; Jarmo 21;
 Levant 120; Rosh Horesha 121; Wadi
 Madamagh 111; Zagros region 130,
 131, 136; Zarzi 109, 114
see also under names of individual species
 Göbekli Tepe 105, 136, 147, 384
 Gobi desert 182
 Godebra rock shelter 274, 310
 Gogo Falls 274, 316
 Goias sites 240
 Goldcliff, South Wales 401, 401
 golden gram 152
 Golson, Jack 217
 goosefoot 241, 242, 244, 245, 388
 seeds 250
 gorgets 122
Gossypium sp. 167
Gossypium arboreum 152
Gossypium barbadense 234, 256, 257,
 264
Gossypium herbaceum 152
Gossypium hirsutum 234, 256, 257
 gourd(s) 2, 22, 252, 264, 388
 bottle, *see* bottle gourds
 rinds 22
 Graeco-Italic-Celtic languages 101
 grain 57, 366
 impressions 365
 ripening season 115
see also cereals; *and under names of*
individual species

- Gramineae seeds 295
 Grampian, Neolithic house 371
 grams, Indus valley 172
 granaries 45, 82, 318
 pits 292
 grape(s) 113, 115, 175, 242, 346, 367,
 377
 Indus valley 172
 pips 167
 grape hyacinths 110
 grass pea 149, 152, 169
 Indus valley 172
 grasses 412
 Africa 322; Nigeria 308; Sahara 294; Two
 Caves 298; Un Afuda 295
 East Asia 187
 Europe 334, 348
 pollen 214
 seeds 61, 204, 247, 268
 South America 262
 South Asia 165: Ganga valley 168
 South-East Asia 185
 South-West Asia 27, 110: Kebara 115;
 Mount Carmel 14
 grasslands 117, 120, 165, 233, 289
 Fertile Crescent 12
 Venezuela 236
 grave(s) 194, 214, 215
 -goods 99, 160, 162, 170, 246, 306, 343,
 407–8
 LBK 358
 mass 363
 markers 287, 314
 see also barrows; burials; cemeteries
 grazing, wetland 376
 grease 125, 331
 great millet, *see* sorghum
 Great Zimbabwe 274, 319
 Greece 24, 87, 337, 356
 artefacts 347
 burial 348
 cattle 91
 colony 277
 grinding 335
 language 101
 material culture 353
 Neolithic sites 325
 red deer 335
 rock shelters 330
 settlements 346
 tells 349
 uplands 351
 wheat 98
 Greek language 101
 green bristlegrass 185, 187, 188
 green grams 151, 152, 177, 203, 387
 Green Mountain, *see* Gebel Akhdar
 Greenberg, Joseph 280
 Greenland 235, 329
 herding 68
 ice cores 116, 117
 reindeer husbandry 394
 greenstone axes 313
 griddles 259
 grinding/grinders 6, 27, 28, 74
 Africa 322; Fayum 290; Maghreb 285;
 Sahara 294, 295, 299, 301; Sahel 305,
 306, South 316, 318; Tushka 287
 Americas 259, 263, 264, 265
 Australia 61
 bowls 133
 Central and South Asia 155
 East and South-East Asia 187, 190, 192,
 200, 203, 212
 Europe 355, 359: Greece 335
 food residues on 113
 slabs 111, 113, 132
 South-West Asia 113, 114, 118, 122, 130,
 133, 134
 Gritille 105, 141
 Grivač 353
 grizzly bear teeth 246
 Grotta Continenza 326, 337
 Grotta dell'Uzzo 326, 336, 337
 Grotta Paglicci 326, 331
 Grotta Romanelli 326, 331
 Grotte Capelletti 274, 299
 ground
 -edge tools 188
 stone axes 311
 tools 23
 groundnuts 282
 Africa 281
 group identity 349
 growth
 lines 91
 rates 403
 grubs 75
 gruel 129, 250, 378
 Gua Bintong artefacts 211
 Gua Cha 183, 213
 artefacts 211

- Gua Gunung Runtuh 183, 213
 Gua Sireh 183, 223
 guanaco 234
 Guatemala 258, 261, 262
 guava 234, 263, 264, 267, 268
 Guayana 232
 Gubbio 350
 /Gui 43
 Guyana highlands 233
 Guilá Naquitz cave 252
 Guinea millet 277
 guinea pigs 22, 31, 234, 269
 Guinea rice, Africa 281
 Guitarrero cave 232, 240, 236
 Gujarat 150, 151
 Gulf Coast 22, 244, 250
 Gulf of Arabah 104
 Gulf of Mexico 242
 Gulf of Siam 210
 Gulf of Sirte 275
 Gulf Stream 332, 334
 guns 151, 402
 gypsum 139
 hachettes 309
 Haçilar 21, 105, 137
 artefacts 347
 hackberry 194, 242, 252, 308
 seeds 306
 Haddenham 326, 372
 Hadza 43, 57
 Hagfet ed-Dabba 285
 hair 87
 hairy storksbill 110
 Hallan Çemi 105
 Hamadong cave 187
 Hamanasumo 203
 Hambledon Hill 326, 372, 377
 hamlets 77: *see also* villages
 hammer-stones 111, 165
 handstones 113, 123, 134, 139,
 285
 Harappa(n) 150, 162
 agriculture 386
 cereals 177
 cities 171
 contexts 283
 economic system 174
 iconography 172
 rice 175
 sites 156
 stamp seal 173
 state 153, 154, 167, 170
 hard wheat 160
 hares
 Africa: Nabta Playa 290, 291; Nile valley
 289; Wadi Kubbaniya 286
 Americas: Gulf of Mexico 242
 Central and South Asia: India 151; Sri
 Lanka 164
 East and South-East Asia: Yagi 201
 Europe 334: Corsica and Sardinia 335;
 Italy 350; Kastritis 330
 South-West Asia 110: Tadrart Acacus
 297; Zagros region 136
 Harlan, Jack 29, 31, 282, 282
 Harleigh Farm 319
 harpoons 74
 Africa: East 314; Ghana 312; Nile valley
 289; North 294, 300; Sahel 305, 306
 Europe: Alpine region 76; Ertebolle
 343
 India 151
 Harris, David 28, 36, 158
 hartbeest 283, 289, 291, 299
 Tadrart Acacus 297
 harvesting 36, 46, 403
 Africa: North 277; nut-grass, Wadi
 Kubbaniya 285
 Americas 245: Peru 271
 Central and South Asia: Jeitun 157;
 Mehrgarh 162
 East and South-East Asia: Chulmun sites
 199; Diaotonghuhan 191
 equipment 28, 263: *see also under names*
 of individual tool types
 experimental work 134
 rice 188, 386
 South-West Asia: Kebara 114; PPNB 139
 wild: plants 86; seeds 299
 see also agriculture; plant cultivation
 Hassa Hesa 305
 Haua Fteah 274, 283, 284, 288, 298
 Barbary sheep 284
 hawthorn fruits 110
 Hayden, Brian 36, 406
 Hayonim
 Cave 105, 118
 Terrace 123, 125
 hazel 334
 nuts 200, 334, 339, 363
 rods 62

- headdresses 126, 310
 Star Carr 338
Head-Smashed-In 232
 healed wounds 339, 345
 healing ritual 319
 health 92, 128, 249, 268, 401
hearth(s) 82
 Africa: Farafra oasis 291; Nabta Playa 290; Nile valley 289; Tushka 287
 Americas: Oaxaca 254
 Central and South Asia: Jeitun 157
 Europe: Slatina 355
 groups 407
 South-West Asia: Beidha 143; Jordan 138; Natufian 118, 126, 132; Ohalo II 111
 hearths of domestication 2, 17–26, 23, 104–48, 281, 384
 heaths 78, 360
Hefsibah 111
Helianthus annuus 241, 243
Hemamieh 274, 292
 hemp 152, 199, 202
Hemudu 183, 195, 196, 198
 artefacts 197
 tools 193
 herd(s)/herding 8, 13, 32, 81, 396
 c. 6000–3000 BC 165–70
 Africa 277; Egypt 292, 293; Ghana 312; Kenya 316; Khoikhoi societies 278; Sahara 295, 300; Sudan 306
 in art 98
 Central and South Asia: India 153, 155, 176; Jeitun 158
 Europe 4: England 375; Italy 350
 Gordon Childe on 14
 herders, Neolithic 9
 management 190, 299
 models 315
 modern 42
 mortality 88
 netted enclosures 125
 rock art 302
 sheep and goats 11
 South-West Asia 383: Çatalhöyük 143; Kebaran 114; Natufian 128; PPNA 135; PPNB 145; Zagros region 136, 137
 systems 329
see also under names of individual species
 Herodotus 277, 304
- heron 197
hickory 245
 nuts 239
 hide (hunting) 51
 hide (skin) 132, 155, 167
 working: tools 127
 hierarchical society 56
Higgs 243
Higgs, Eric 17, 29, 30
 highland forests 209
 highlands, Central America 251–4
 high-status foods 36
 hill farm 68
Hill Pandaram 43
Himalayas 106, 108
Hindu Kush 150, 155
 caves 158
 mountains 155
Hippo Tooth 274
hippopotamus 286, 289, 292, 294, 305, 335
 ivory 300, 306
 historical
 linguists 99
 sources 74
 history, misuse of 10
His-yin-ts'un 183
Hoa Binh 183, 210
Hoabinhian
 artefacts 211
 caves 214
 foraging communities 212
 technology 210
 tradition 188
Hobbes, Thomas 44
Hodder, Ian 33–4, 39, 91, 410
Hoëdic 326, 344, 369
 hoes 35, 76, 191, 193, 220, 244, 249, 311, 312
 waisted 263
hog deer 165, 168, 169
Hoggar 275
Hohokam 247, 249
Hokkaido 201
Holocene
 Africa: East 314; Sahara 304
 Australia 227
 climate: change 19, 73, 135, 210, 239, 288, 321, 332, 379, 403; history 79
 climatic optimum 184, 337
 desert sites 291
 diminution 30, 88

- Holocene (*cont.*)
 domestication 3: animal 298, 300; plant 384, 398
 East Asia, farming, 189–99
 evidence for farming 2
 exchange networks 391
 faunal remains 297
 foragers 99, 162, 312, 379, 412: Andes 268; Central America 253; Europe 335–8; Mexico 252; North America 242; Thailand 213
 forest: disturbances 259; manipulation 217, 221
 Greece 335
 herding 156
 horticulture 260
 humid phase 294, 305, 307
 hunter-gatherers 10, 14, 39
 intensification 260
 interglacial 117
 Korea 199
 lake levels 118
 landscape 333
 microlithic industry 155
 mixed farming 383, 387
 population increase 93, 400, 402
 rainfall 289
 sedentary societies 34, 287, 399
 settlement 21–2, 137, 153, 223
 South America 262: Peru 236
 subsistence 190, 397
 taro 218
 temperatures 27
 transition to 1, 131: *see also* Holocene, climate change
 vegetation 255, 334: change 310
- 'Homo economicus'* 34
Homo erectus 396
Homo sapiens sapiens 396
 Honduras 259
 honey 52, 151, 319, 366
 hoof
 impressions 176
 -prints, rock art 331
 hooks 347: *see also* fishing equipment, hooks
 Hopewell 245
 centres 246
 Interaction Sphere 246
Hordeum pusillum 241
Hordeum spontaneum 106, 107, 115
- Hordeum vulgare* 106, 152
 hormones 383
 horn 2
 cores 136, 139, 155
 hornbills 207
 feathers 44
 horse(s) 1, 5, 403
 bones 329
 domesticated 31: Americas 235, 401; Eurasian steppes 96; Europe 98
 riding 329
 in rock art 302, 329, 330
 wild: Europe 330, 331, 334; Tehuacán valley 237
 Horse Cave 154
 horsegream 151, 152, 176
 horticulture 396, 399, 403
 Africa: Cameroon 312; Ethiopia 287;
 Nabta Playa 292; Nile valley 321;
 Sahara 304; West 314, 322
 Americas 388: Aguadulce 259; eastern 245, 246, 290; Ojibwa-Chippewa 66; Peru 22
 East and South-East Asia 226: China 195; island Melanesia 225; Jomon 202, 204; Malay peninsula 214; Papua New Guinea 70; rainforest foragers 207; Spirit Cave 212
 Europe 345: Mediterranean 352
 South-West Asia 129: Natufian 387
 see also gardens; dooryard horticulture
 hospitality 406
 Hottentot 324
 house(s) 45, 49, 77, 82, 116, 191, 194, 291
 architecture 162, 246
 -byres 77
 floors 264
 mud-built 21
 Neolithic 371
 pit 199
 pole and thatch 265
 PPNB 138, 138, 143, 144
 structures 130
 types 15
 see also dwellings; huts
 house sparrow 120, 393
 house-fly 81
 households 45, 261, 345
 extended 356
 Scandinavia 343

- howler monkey 241
hu vessels 195
Huaca Prieta 232, 267
Huai river 182
Huanghe river 182, 183, 189, 200
 basin 194
 valley 190, 192, 195, 199, 387
Huorani 43
Hudson Bay 66
Hulijingzi, tools 193
human
 agency 398
 behaviour 392, 396
 diet 89
 effigies 345
 -fish boulders 410
 imagination 414
 remains 92–6, 187: skulls 129, 207; teeth 73; Vedbaek 344; *see also* burials; cemeteries
humidity 289, 294
Hungary 357
 pollen 354
Hungorob ravine 274, 319, 320
Hunter's Home 232
hunter-gatherer societies 14, 15
 definition 42
 Europe 10
hunting 47, 51, 406
 c. 6000–3000 BC 165–70
 Africa: Kenya 316; Libya 283; Sahara 294;
 Sahel 308
Americas: Central 260; eastern
 Woodlands 245
Australia 62, 63
buffalo 402
communal 126, 128, 284
dogs, use of 51, 63, 387
drives 65
East and South-East Asia: Malay
 peninsula 213; New Guinea 221;
 Zengpiyan 190
equipment 132, 139, 151, 300, 312
Europe 4, 345: camp, Star Carr 338;
 Denmark 340; Franchthi Cave 336
Ice Age 4
models 315
in rock art 302
seasonal 331
selective 31
sheep 27: *see also* sheep, wild
South-West Asia 27, 129: Kebaran 114;
 Mehrgarh 160
station 288
systems 223, 236
techniques 329–30
technologies 194, 379
territories 48
 see also under names of individual species
Huon peninsula 183, 209
husbandry 26, 45, 134, 396, 412
 Australia 62, 394
 East and South-East Asia: Hemudu 195
 Europe: Greece 346; Italy 351; Spain 352
 Greenland 394
 practices 405
 rice 186
 South-West Asia 27: Early Natufian 146;
 Zagros region 130
systems 158, 353, 358, 367, 390
 see also agriculture; farming; herding;
 plant cultivation; stock-keeping; *and under names of individual species*
husks 82
Hutouliang 183
huts 111, 168, 292, 293
 compounds 350
 conical 165
 floors 176, 290
 LBK 358
 mud-plastered 305
 plaster-floored 316
 trapezoidal 340
 see also dwellings; houses
Hutu 324
hyacinth bean 151, 152
 Indus valley 172
Hydrochaeris hydrochaeris 241
hyenas 5, 98
hyperostosis 307
Hyphaene thebaica 285, 306
hyrax 299
Iberian peninsula 337
Iberomaurusian layers, Haua Fteah 298
ibex 98, 109, 129, 331, 336, 337
ice
 cores 116, 117
 sheets 12, 239
Ice Age(s) 1, 22, 79
 hunting 4
Icehouse Bottom 232, 239, 244

- Iceland 332
 Iceman 401
 Icoana 326, 340
 iconography 98–9
 Harappan 172
 identity 378, 406, 409, 411
 ideology 39, 147, 385, 391, 407–10, 411
 Neolithic 38
Ignatia feuillei 264
 Iliriki 183, 202
 Ilsan City 183
 immediate return system 49
 immunization 57
 imperialism 271
 Impressed Ware 335, 349
 impressions
 basketry 139
 cord 197, 212
 finger millet 312
 grain 365
 plant 82, 312, 215, 305
 rice 174
 seed 308
 Inamgaon 150, 177, 178
 Inca(s) 234, 269
 empire 233
 state 270
 incense tree 311
 incidental domestication 35
 incised designs 99
 India(n) 13
 ancient civilization 11
 cattle 96, 164, 168, 169, 169, 304, 321
 Mesolithic 165
 migration to 24
 millets 386
 Nayaka 60
 North-West 155–64
 pulses 386
 rainfall 149
 rice 175, 153
 rock art 166
 sorghum 282, 294
 sub-continent 389
 transitions to farming 175–8
 see also Ganga valley
 Indian Kroll 245
 Indic languages 101
 Indo-European
 farmers 385
 languages 99–101, 101, 167, 327, 391,
 409
 Indo-Iranian languages 101
 Indonesia 81, 102, 226
 Indonesian Papua 223
 Indo-Pacific languages 99
 Indus valley 149, 391
 farmers 386
 Harappan state 153
 Mesolithic stone technologies
 168
 millet and rice farming 170–75
 riverine resources 165
 urban civilizations 2
 Industrial Revolution 10
 infanticide 29, 57
 infra-red spectroscopy 290
 inhabitants, first, Americas 235–9
 Initial Yayoi site 205
 initiation 302, 304, 319
 injuries 94, 89, 93
 Innu 43
 insects 79, 81
 intelligence 383
 intensification 398
 Africa 312
 Americas 259: Caquetá valley 267;
 Central 261; Hopewell 246; Panama
 260; South-West 248
 Europe 335: cereal production 356
 South-West Asia 399: Mehrgarh 167
 interlacustrine region, Africa 275
 interments 293: *see also* burials; cemeteries
 interventionist
 relationships 412
 strategies 263
 Inuit 56, 402
 Inupiat 43
 invention 411
 Ipomoea Revolution 220
Ipomoea batatas 185, 234, 256, 257, 264
 Iran(ian) 21, 24, 104, 106, 108, 109, 136,
 154, 160, 384
 Deh Luran plain 20
 eastern 165
 languages 101
 littoral 171
 millet 173
 plateau 11, 137, 149, 150, 158, 167,
 385
 South-West 21
 Iraq 21, 24, 108, 136, 137, 140, 384
 Iraq ed-Dubb 105, 132, 135
 Iraq-Jarmo Project 22

- Ireland 332, 339, 372, 391
 field systems 375, 375
 transitions to farming 370–8
- iron
 axes 151
 deficiency 307
 furnaces 316
 metallurgy 311
 technology 389
 working 278, 313, 316, 322
- Iron Age 4, 15, 101, 316
 farmers 278
 pottery 390
 settlements 318
 societies 319
 plants 317
- Iron Gates 326, 340, 354, 356
 village 341
- irrigation 11, 61, 105, 174, 263, 268, 276, 304
 systems 249
 technology 246, 247, 248
- Islamic times 304
- island(s)
 -hopping 235
 Mediterranean 11
- island Melanesia 186, 210, 217
 farming 224–7
- Island South-East Asia 102, 182, 209, 218, 387, 412
 farming 217–24
- isotope(s) 92, 94, 143
 carbon 95, 270
 clay fabric 76
 data 390
 diet 94–5, 265: Americas 250, 267, 268, 270; China 187, 194; Europe 344; Jomon 201
 evidence 377
 foraminifera 79
 human bone 94–5, 187, 194, 201, 250, 265, 267, 270, 344
 nitrogen 94–5, 270
 oxygen 79, 91
 phytoliths 76
 plant remains 76
 shell 91
 signatures 341
 starch grains 76
 strontium 363
- Israel 21, 104, 108, 121, 123, 146, 384
 northern 14
- Italic language 101
 Italo-Celtic languages 101
 Italy/Italian 328, 331, 337, 349, 351
 Alps 92
 –French border 350
 Neolithic 75
 peninsula 349
 Renaissance 74
 rise of Fascism 10
 settlement 350
 shepherd encampment 78
 –Swiss border 336
- Itatsuke 183, 204
- Itenm'i 43
- Iva annua* 239, 243
- Iversen, Jens 79
- ivory
 bracelets 306
 hippopotamus 300
- ivy 81
- jacima 267
- jackals 160, 165
- jade 203
- Jahai 43
- James Bay Cree 43
- Japan 182, 188, 235, 253, 387, 399, 402, 413
 transitions to farming 199–205
- Jardinga 326, 343
- Jarman, Mike 29–30
- Jarmo 25, 26, 105
 settlement 21
- jasper 351
- Java 182, 186, 206, 217
- Jawa 124
- Jebel Moya 274
- Jebel Sahaba 274, 287
- Jeitun 150, 157, 157, 158, 386
- Jenne-jeno 274, 310
- Jerf al-Ahmar 105, 136, 147
- Jericho 21, 22, 129, 131, 134, 137, 140, 143
- jewellery 126, 214, 343, 407, 408: *see also under different materials and jewellery types*
- Jiahu 183, 194
- Jiangzhai 183, 198, 199
- Jiebmaluok'ta rock carving 69
- Jivaroan people 59
- Joara, rock art 166
- John river 66
- joint-pine 110

- Jomon 200
 coastal settlement 201
 period 203
 settlement 203
 sites 202
 subsistence 202
- Jordan 21, 80, 104, 110, 121, 138, 142, 384
 Basta 138
 copper 142
 desert 121
 early farming communities 21
 Kebaran sites 110
 plateau 121, 135
 steppes 124
 valley 108, 109, 125: cereals 117, 146; lakes 118, 129; Ohalo II 111, 114
 Wadi Faynan 80
- Ju/'hoansi 43
 jujube 149, 168
 fruit 160
 Indus valley 172
 jungle cat 160
 juniper 334
 berries 247
 seeds 250
- Jura 341
Justicia 208
 Jutland 365
 Juyupri 183
- Kabbashi 274
 Kabbashi al-Haitah 305
 Kachi plain 159
 Kadero 274, 306
 Kadzi 274, 316, 317
 Kal Beliyas 151
 Kalahari desert 29, 42, 48, 55, 62, 275
 foragers 323
 San 98, 278: *see also* Bushmen; !Kung
 San Bushmen; San Bushmen
- Kamikuroiwa 183, 188, 200
 Kamitakatsu 183
 Kara Kamar I 150, 155
 Karacadağ mountains 108
 Karanovo 326, 353
 culture 354
 Karelia 343
 Karkarichinkat 274, 309
 Kastritsa 326
- Kawaji 183, 200
 kayaks, seagoing 241
 Kazahari 183, 204
 Kazanluk 326
 Kebara(n) 105, 110, 116
 foragers 109–14, 128
 gazelle 123
 population 125
 sickle haft 127
 Keep river area 75
 Kelabit 406–7
 Kelaniya river 164
 Kending 183
 Kent, Neolithic house 371
 Kentucky 244
 Kenya 309, 314
 fauna 315
 Kenyon, Kathleen 22, 131
 Kerma 274, 307, 310
 sheep 87
Kerstingiella geocarpa 282
 Ket 43
 Kgaswe 317
 Khanti 43
kharif crop system 149, 151, 167, 171, 173, 176
 Khartoum 274, 305, 306, 307
 region 278
 Khashm el Girba 274
 Khazineh 20
 Khoi foragers 317
 Khoikhoi societies 278
 Khoisan language 99, 279, 279
 Khok Phanom Di 83, 183, 214, 387
 pottery 215
 Khong stream 212
 !Khuisib delta 274, 319
 kill
 ages 167: Star Carr 338
 patterns 284, 285
 sites 168, 238
 kilns 194
 Kilu 209, 225
 Kilwa 274
 Kimberley 43
 kings 1
 kinship 46, 54, 55, 409
 structures 248
 Kintampo 274, 309, 312
 Kiowa 222
 Kipp Island 232

- kitchen gardening 383
kites 123, 124
stone 140
kivas 248
Klasies River Mouth 274, 283, 321,
396
Klithi 326, 330
Knap Hill 326, 372
Knap of Howar 326, 371
knives 74, 151, 194, 204, 214
Knossos 325, 326, 346, 348
knotweed 241, 245, 388
kob 305
kodo millet 152
Kokasut 274
Koldihwa 150, 169, 174
Köln-Lindenthal 326, 357
Kom 292
Kom Ombo 274
komgoni 314
Koobi Fora 274
Korčula 349
Korea(n) 204, 387
peninsula 182
transitions to farming 199–205
Körös 353, 361
culture 354
sites 356, 360
Kosipe 183, 209, 209
Kosrae 225
Koster 232, 242, 245
squash 243
Kourounkorokale 274
kramkram 308
Kria cave 223
Ksar Akil 105, 111
Kubu 64
Kuchi 151
kudu 305
Kuk 183, 217, 218, 219, 219, 220, 220, 221,
398
Kum basin 121
!Kung San Bushmen 29, 42, 48, 55, 56, 57,
62, 98; *see also* San Bushmen; Kalahari
San
Kunjhun 150
II 176
Kuper, Adam 318, 318
Kurdistan, Iraq 21
KwaGandaganda 318
Kwakiutl 49, 56
KwaZulu-Natal 316, 317, 318
Kyushu 204
L'Anse Amour 232, 241
La Blanca 261
La Elvira 232, 240
La Emerenciana 232, 264
La Esperanza 240
La Fru rock shelter 326, 331
La Galgada 232, 267
La Hoguette 363
La March, rock art 330
La Mula 232, 240, 259
Laang Spean 183, 213
Lablab 178
Lablab purpureus 152
labour 46
differentiation 345
division of 401
Labrador 231
Lachitu Cave 183, 209, 224
lacquer ware 203
lactation 57
lacustrine
resources 399
sediments 79
ladles 76
Laga Oda rock shelter 274, 287
Lagenaria 204
Lagenaria siceraria 202, 234, 256, 264
lagomorph 335
lagoons 242
Lahari shelter, rock art 166
lake(s) 289, 404
edges 314: vegetation 338
pollen 175
sediments 18, 190, 259
-side settlement 198
villages 9, 76
Lake Assad 136
Lake Ayauch 232, 267
Lake Aziscohos 237
Lake Besaka 274, 310
Lake Bosumtwi 274, 312
Lake Chad 307, 308, 309, 310
Lake Geral 232, 267
Lake Hordorli 183, 222
Lake Junin 232, 268
Lake La Yeguada 232, 239, 259
phytoliths and charcoal 260
Lake Ontario 250

- Lake Penet Itza 232
 Lake Petapilla 232
 Lake Titicaca 232
 Lake Turkana 274, 309,
 314
 Lake Victoria 275, 283, 323
 Lake Winnipeg 231
 Lakshajur hill, rock art 166
 Lalibela 274, 310
lalud 407
Lama glama 234
Lama pacos 234
 lambing 68
 lances 165
 land 46
 clearance 46
 occupation 391
 ownership 383
 tenure systems 62
 -use systems 276
 land snails 27, 305
 landscape(s) 50, 78, 99, 220
 alluvial 348
 change 385
 intervention 396
 management 376
 markers 343
 Mediterranean 337
 Neolithic, Early 373, 377
 transformation 261: European 332,
 333
 watery 353
 Lang Rongrien 183, 213
 Langhnaj 150, 175
 language(s) 99–102
 Africa 279, 279
 evolution 101
 families 409
 groups 60
 origins 3
 /people dispersal models 280
 see also under names of individual languages
 langurs 207, 212
 Lanlory 317
 Laos 182
 lapis lazuli necklace 160
 Lapita
 burials 225
 material culture 387
 pottery 217, 224, 226
 Lapp
 herders 68
 herding systems 329, 394
 Las Haldas 232, 267
 Las Varas 232
 Lascaux 45
 Last Glacial Maximum 397
 Africa 283, 287
 Americas 235, 236
 Central and South Asia 154
 East and South-East Asia 187, 188, 190,
 205, 206, 386
 Europe 328, 329, 332, 378
 flooding 398
 population movement 97
 South-West Asia 109, 146, 384
 Late Glacial 19, 28
 East and South-East Asia 187, 188, 190,
 210
 South-West Asia 116, 117, 130
 subsistence 331
Lates 305
Lathyrus sativus 152
 Latin 101
 latrine deposits 82
 Laurentide ice sheet 235
 Layton, Robert 412
 lazy-beds 250
 LBK culture, *see Linearbandkeramik culture*
 leaching 63, 65
 Leang Burung 183
 leap-frog colonization 361
 leather 2, 76
 working 158: tools 139
 leaves 151
 Lebanon 104, 108
 Lee, Richard 29
 legumes 95
 domesticated: Africa 310: Americas 263,
 265, 267: East and South-East Asia
 185: Europe 346, 348, 350, 367, 374:
 South-West Asia 108: PPNB 140, 145
 pre-adaptation to domestication 403
 wild 27: Africa 290: Americas 237, 262:
 Central and South Asia 153: East and
 South-East Asia 212, 213: Europe 336,
 352, 353, 384: South-West Asia 106,
 111, 121, 122: PPNA 135; Tell Aswad
 134; Zagros region 136: *see also*
 vegetables; *and under names of individual species*

- Leguminosae, *see* Fabaceae
leisters 343, 353
leisure 28, 29, 44
Lekhahia 150
Lene Hara cave 183
Lens culinaris 152
lentils
 domesticated: Africa 285, 292, 293:
 Central and South Asia 149, 152, 169,
 172, 175: Europe 346: South-West
 Asia 134, 135, 139
 wild: Europe 336: South-West Asia 106,
 120, 135
leopard(s) 393
 in art 394
Leopard's Kopje 317
Lepenski Vir 326, 340, 341, 356, 410
 culture 354
Lepidium meyenii 269
Lepidium perfoliatum 122
leren 257, 259, 263, 266
Lesotho 288
Lesser Celandine 341
lesser gymnure 206
Levant 130, 155, 194
 Afro-Asiatic people 280
 artefacts 347
 burial customs 143
 cereals 146, 384: einkorn 106
 farmers 346
 game 109
 Kebaran sties 110
 northern 14
 obsidian 142
 plant foods 114, 116
 PPNB 137
 sedentary communities 140
 southern, Natufian 117: *see also* Natufian
 tools 113
Levantine corridor 104, 105, 118, 398
 plant cultivation 134, 404
 PPNA 131, 135
 settlement 120, 121, 128, 136
levees 218
LGM, *see* Last Glacial Maximum
Libby, Willard 17
Libya 275, 277, 304, 337, 397
 cave art 100
 eastern 106
 faunal remains 297
 mountains 294, 295, 296
population 302
rock art 303
Libyco-Caspian layers, Haua Fteah 298
Licuala spinosa 213
life expectancy 57
Lilou, tools 193
lima bean 234, 267
lime
 fruit 265
 tree 332
lime
 mortar 340
 plaster 139
limestone 138
 statuette 127
Limfjord 365
limpets 288, 341
lineages 199
Linear Enamel Hypoplasia 136
Linearbandkeramik culture 98, 357–64
 farmers 368
 longhouses 359, 371
 pits 357
 pottery 363, 365
 settlement 358: areas 365
 sites 362
linen 139
linguistic(s) 3, 73, 310, 311, 321
 diversity 217, 280
 families 235
 groups 316
 studies 278–80
Linnaean taxonomies 59
linseed, Indus valley 172
Linum usitatissimum 152
Lipari 349
lipid residues 378
Lipscomb 232, 237
Lisan Lake 109
Lismore Fields 326, 371, 371, 372,
 377
lithic
 assemblages 262, 350, 370
 industries 154, 348
 technology 114, 116, 132, 139
 tools 203, 223, 301
Lithuanian language 101
little barley 241, 245
little forest 407
little millet 150, 152
Little Tennessee river 239

- livestock 1, 72
 Africa 278
 buildings for 77
 Central and South Asia 151
 Europe 349, 366, 368
 grazing 140
 herded 15, 143, 276
 mortality data 161
 PPNB 145
 products for 2
see also stock-keeping; and under names of individual species
- lizards 207, 251, 258
 llamas 22, 87, 234, 237, 403, 269
llanos 267
 Løddesborg 326
 loess 361
 soils 194, 357
Lolium 135, 292
lomas 233
 long barrows 371, 373: *see also* barrows
 long-fallow cultivation systems 267
 longhouses
 Americas 251
 design 374
 LBK 357, 359, 363, 371, 372
 South-East Asia 77, 196, 203: Kelabit 407
 Longshan 189
 loom 355
 -weights 76
 lords 1
 Los Grifos 240
 Los Millares 352
 Los Tapiales 232, 240
 Lothal 150, 174
 Lowasera 274, 314
 Luano 274, 316
 lucuma 267, 268
 Lukagir 43
 Lummi 65, 66
 lungfish 305
 Lusitania 232
 luxury goods 45
 Lydenburg 274
 valley 316
- Maadi 293
 Mabveni 274, 316
 maca 269
 macaques 207, 212
- mace-heads 306
 Machalilla 266
 MacNeish, Richard 22, 23, 251
Macrotyloma 178
Macrotyloma uniflorum 152
 Madai 183, 223
 Madden Lake 232, 240
Madhuca 212
 Madhya Pradesh 165
Maerua crassifolia 299
 Magan 171
 Magdalena 233
 sites 240
 valley 232, 263
 Magdalenian
 culture 329
 foragers 330
 reindeer hunters 45
 Maghreb 275, 283, 285, 294, 300
 Maghzaliyah 105, 137
 magicians 45
 Maglemosian sites 339
 Magogo 317
 maguey 237, 252, 253
 cultivation, Central America 251–4
 Mahadaha lake, faunal remains 169
 Mahagara 150, 164, 168, 169, 174, 176
 rice 170
 Mahasati mound 168
 mahogany 308
 Maine 251
 Mainstone 371
 maize 1, 11, 255, 405
 beer 271
 domesticated 24, 31: Americas 22, 207, 249–51, 410: Bat Cave 246; California 62; Central America 19, 251–4; Mexico 257; North America 95, 242, 249–51; South America 264, 266; South-West 388: Borneo 63
 isotopic studies 270
 pollen 22
 rations 271
 wild 36
 Majiabang 183, 198
 Makhadma 287
 Makriyalos 326, 348
 Malabar gourd 234, 257
 Malawi 316
 Malay peninsula 182, 213
 Malayo-Polynesian language 102

- Malaysia 206, 213, 217
Mali 275, 283, 294, 309
mallets 197
malnutrition 411
Maluku islands 222, 223
Mamba 274
mammals, *see animals; and under names of individual species*
mammoth(s) 4, 5, 7, 87, 235
Mammoth Cave 232, 244
Man Makes Himself 9, 10, 14
Man the Hunter 28, 55
Manaus 232, 267
Manchuria 182
Manekweni 274, 319
Mangaia 227
mangrove
 forests 184, 208
 swamps 171, 190, 206
Manihot esculenta 234, 256, 257, 264
manioc 1, 85, 86, 388
 Africa 277, 311
 Americas 234, 258, 388: Aguadulce 259;
 Amazonian lowlands 269; Belize 261;
 Caqueta valley 265; Central and South
 America 257, 264, 266; Gulf of Mexico
 242; Peru 263
Borneo 63
 cordage 247
Mantaro valley 269
 isotopic values 270
manure 2, 140, 151, 276, 317, 360: *see also*
 dung; faeces
Maori 217
 gardens 227
maples 201
Mapungubwe 274, 316, 319
Maranta arundinacea 256, 257, 258
Marantaceae 258
Marble Bluff 232, 245
marginal
 environments 383
 zone hypothesis 28
Marianas Islands 225
marine
 -based foraging 267–8, 396
 carbonate curve 109
 foods 94, 95, 215, 225, 339, 345, 377,
 387: *see also under names of individual species*
 resources 47, 235, 399
sediments 79
shells 142, 167, 246, 313: *see also molluscs*
market 1
marmot 331
marriage 145, 249, 339, 366
 China 387
 dowries 146
 inter- 390
 and land ownership 55
 patterns 345
 ties 66
marrow 257
marsh(es) 289, 306
 seeds 139
 soils 157
marsh elder 239, 242, 243, 245, 388
marten 212
Marx, Karl 54
Masai herders 74
masks 143
mass spectrometry 76, 95
massacre 363
Massif Central 329
mastodon 237
Matabeleland 317
Matenbek 183, 210
Matenkukum 183
material culture 15, 74–6, 116, 203, 293,
 300, 356
 Bantu 390
 Cyprus 346
 Greece 349, 353
 Mesolithic 17
 Neolithic 223, 347, 408
 Sahara 294
 see also artefacts
mating habits 403
Matlapeneng 317
Matola 274, 316
Matope Court 274, 316
matrilocality 129
mats 139
mattocks 75, 76
 Star Carr 338
Maunatlala 317
Mauritania 275, 308, 313
Maya 259
 polity 261
maygrass 241, 244, 245
mayweed 292
Mazama americana 241

- Mazatán 232
 Mbuti 43
 pygmies 128
 Mdaga 274
 Meadowcroft rock shelter 232, 236
 meanders 242
 medicines 2, 57, 121, 151, 213, 244, 388
 medieval philosophers 57
 Mediterranean
 agro-pastoralism 346
 ancient civilization 11
 climate 276, 351
 coast 110, 276, 350
 cultures 325
 eastern 108
 ex oriente lux 16
 farming 352, 356
 forager-farmer societies 349, 406
 France 363
 iron working 313
 islands 413
 landscape 337
 littoral 104, 109, 118
 plant remains 111: cultivars 336;
 legumes 106; oak and lime 332
 polyculture 352
 Sea 335
 shells 129, 142
 -style climate 275
 megalithic tombs 368
 Mehmeh 20
 Mehrgarh 150, 158–60, 162, 167, 173, 386
 animal size 163
 buildings 159
 fauna 161
 Meilgaard 326, 343
 Melanesia 182, 185, 217, 222, 387: *see also*
 island Melanesia
 melon 62, 152, 202
 Indus valley 172
 Melos 326, 335
 Meluhha 171, 173
 Meniet 274, 299, 309
 mental maps 346, 361
 Mercati, Michael 74
 Merimde 274, 292
 Meroë 313
 Meroitic population 307
 Merrimack river 232
 Merzbach valley 362
 Mesa Verde 232, 248
 Mesakin 34, 91
 Mesoamerica 19, 24, 33, 36, 40, 96
 domestication 2
 social complexity 28
 Mesolithic 4, 10, 116, 153, 328
 artefacts 370
 burial 344: Denmark 407–8, 408
 communities 345
 Europe 14, 75, 392
 faunal remains 169
 foragers 337, 363, 408
 Haua Fteah 298: Barbary sheep 284
 hunters 5
 India 165
 material culture 17
 /Neolithic dichotomy 328
 populations, Europe 334
 resource scheduling 342
 rock art 166
 settlement 353
 sites 30, 89
 skeletons 95, 96, 369
 societies 170, 227: Europe 239
 stone technology 168
 strandloopers 343
 Wales 401
 Mesopotamia(n) 11, 145, 173, 386
 ancient civilization 11
 states 171
 urban civilizations 2
 mesquite 237, 242, 247
 pods 250, 252
 Messak Settafet 100
 engravings 303
 metal artefacts 63, 154, 171, 216, 278, 291,
 387
 axes 151
 cultivation tools 204
 sickles 321
 see also under names of individual metals
 metallurgy 167, 173, 177, 200, 204, 214,
 280, 281, 313
 metamorphosis 410
 metaphor 58
 methodologies, plant identification 255
 Metroxylon 185
 Mexico 96, 231, 236, 251, 257, 258, 261,
 264, 388
 border 250
 highlands 251
 north-eastern 22

- north-western 246
 Tehuacán valley 20
 western 254
 mice 120, 393
 hair 215
 microfauna 79
 microlithic/microliths 128, 170, 290
 flint: industries 294; tools 132, 287, 295,
 316
 hunting technology 194
 Star Carr 338
 microwear studies 122, 125, 155, 208
 middens 91, 200, 201, 245, 248, 316, 318
 Middle East 277
 Middle Niger delta 308
 Middle Ogooué valley 274
 migration(s) 26, 383, 411
 Africa 278, 293, 299; Kenya 314, 315;
 Proto-Bantu speakers 281; sorghum
 282
 Americas 236
 birds 27
 East Asia 385
 Europe 378, 390; Balkans 361
 farmer 16, 409
 herbivores 237
 models 98, 323, 324, 329, 386
 reindeer 329, 330
 routes, caribou 67, 68
 Mikea 43
 Milagro 232
 Mile 285
 Militarev, Alexander 280
 military service 271
 milk/milking 57, 78, 89, 145, 151, 171, 291,
 315, 378, 406
 products 76
 in rock art 303
 milk fish 31
 Millaran cultures 352
 millet(s) 95, 187, 189
 domesticated 31; Africa 82, 173; Bantu
 278; Nile valley 277; Nubia 307; Sahel
 308, 389; Central and South Asia 149,
 150, 149; Deccan 176; Harappan 156,
 174, 177; Indus valley 172; Iran 173;
 East and South-East Asia 192, 195,
 199, 387; China 185, 413; Jomon 203,
 204; Europe 354
 wild: Africa 290; Sahara 294, 304, 321;
 Tadrart Acacus 298, 299; Australia 60;
- Central and South Asia 153; East and South-East Asia 188; China 194, 386
 impressions 305
see also under names of individual species
 milling equipment 194
 stones 285
 Minas Gerais State sites 240
 mines, flint 371, 377
 mink, domesticated 394
 Mira 337
 Mirabib 274, 317
 Mirzapur 165
 rock art 166
 Mithan cow 403
 Mithen, Steve 411
 mixed economy 316
 M'lefaat 105, 136
 mobile
 foragers 44, 47, 77, 268, 340, 385, 396,
 397
 hunter-gatherers 46
 and social structures 54, 55
 societies 350
 systems 263, 391
 see also mobility
 mobility 70, 72, 394
 Africa 314, 315
 Europe 356; Britain 372; LBK 361; TRB
 367
 Malaysia 213
 North America 239
 tethered 360, 375, 380, 391
 Zagros region 130
 Modoc rock shelter 232, 239
 Mogollon 247
 Moh Khiew 183, 213
 Mohammad Jaffar 20
 Mohenjo-daro 150, 170, 171
 stamp seal 173
 molecular
 biology 73
 genetics 41
 phylogenetic techniques 96
 molluscs 87–92, 169, 171, 188, 208, 286,
 334, 340
 freshwater 305
 shells 79, 190
 molong 63
 Mongolian gerbil, domestication 394
 mongongo trees 62
 Mongranillo 232

- monitor lizard 151, 164, 207
 monkeys 52, 213, 258, 393
 in art 394
 monsoons/monsoonal 154, 190
 belts 288
 forest 213
 rainforest, China 184, 184, 185
 Monte Alegre 232
 Monte Verde 232, 236
 monuments 98–9, 245, 368, 371, 384
 burial 363, 367
 see also barrows; long barrows
 moose 65, 237, 393
 Morava
 river system 354
 valley 353, 356
 moray 201
 Morgan, Lewis Henry 54
 Mori, Fabrizio 302
 Moro 34, 91
 Morocco 275
 mortality 401, 411
 childhood 268
 data 291
 gazelle 123
 profiles 284
 structures 139, 351
 mortar(s)
 Africa 312
 Americas 265
 bedrock 122
 East and South-East Asia 203, 210
 South-West Asia: Jeitun 157; Kebaran
 113; Natufian 116, 119, 121, 122, 132;
 PPNA 134
 see also grinding
 mortar lime 340
 Morton 326
 mortuary
 enclosure 373
 pits 245
 practices, PPNB 144
 ritual 251
 see also burial
Morus berries 204
 Mossby 326, 365
 mouflon sheep 11, 96, 106, 156, 158,
 248
 mounds 219, 268
 burial 371: *see also* barrows; long
 barrows
 ceremonial 265
 settlements 346
 Moundville 232
 Mount Carmel 14, 105, 110
 Mount Hebron 114
 Mount Kinabalu 206
 Mount Sandel 326, 339
 Mozambique 316, 319, 323
 mtDNA, *see* DNA, mitochondrial
 mud 14, 132
 brick 14, 138, 137, 139, 159, 160
 houses 21
 Mugharet el Wad 105, 116
 mulberry trees 189
 mule deer 247
 Mullu Kurumbu farmers 60
 multicausal 383
mulun sebulang 407
 mummies 92
 Mundigak 150, 167
 mungbeans 151, 176
 muntjak deer 164, 197
 Mureybit 105, 118, 121, 125, 126,
 135
 Murray valley 227
Musa sp. 185, 219, 312, 313
Musa acuminata sp. 219
Musa × paradisiaca 277
Musa × sapientum 277
 mushrooms 213
 musk ox 31, 88, 393,
 397
 Mussai islands 183, 225
 mussel shells 192
 mustard 110, 149, 290
 Indus valley 172
 seeds 250
 mutualism 392–4
 Myanmar 149, 186
 Mylouthkia 105, 346
Myotragus balearicus 335
 mythology 59, 324, 409
 Mzonjani 274
 Nabta Playa 274, 291
 community 292
 sorghum 290
 Na-Dene 236
 Nahal Hamar 105, 139
 Nahal Oren 22, 105, 111, 123, 129
 Naivasha 315

- Nakuru 315
 Namib 275
 desert 319
 hunter-gatherers 319
 Namibia 276, 317
 rock art 320
 Namoratunga 274, 314
 Nanzhuangtou 183, 187, 195
 Napolean Hollow 232, 243
 Naqada 292
 Inara melon 319
Nasua nasua 241
 National Museum, Copenhagen 4
 native Americans 59
 Natufian(s) 14, 154, 253, 384, 389, 397
 Abu Hureyra 36
 burials 129
 culture 280
 diet 111
 falconry 112
 foragers 116–30
 game drives 125
 gazelle 123
 horticulture 387
 Late 128–30
 life 187
 sculpted objects 127
 shelters 138
 sickles 139
 sites 22, 31
 structures 119, 132
 natural selection 383
 naturalism 59
 nature:culture dichotomy 58
 Nayaka 43, 60
 Ndondondwane 274, 316, 317
 Nea Nikomedea 325, 326, 346
 artefacts 347
 Neanderthals 396
 Near East 14, 24, 104, 187
 domestication 2
 farmers 145
 hunters 12
 PPNB villages 399
 Nebraska 237
 necklaces 126, 160, 170, 214, 343
 stone 168
 needles 76, 197
 negative reciprocity 46
 Negev desert 120, 121, 128, 141,
 142
 Negra I 232
 Nelson Bay Cave 317
 Nemrik 105, 132, 137, 143
 Nenana valley 232
 Nene valley 372
 Nenumbo 224, 225
 Neolithic 97, 147, 154, 328, 356
 /Afro-Asiatic migration 299
 agriculture 13
 artefacts 347, 370: axes 4
 Beidha 142, 142
 buildings 371
 burial 216: barrows 374; Denmark 408,
 408; mounds 6
 colonists 348, 349, 353, 370, 378, 391,
 405
 colonization 167, 385
 cultural sequence 368
 cultures 131: Balkan 15; Europe 364
 dispersal 387
 Early: farmers 354; landscapes 373, 377;
 pottery 367; skeletons 369; tools
 193
 Europe 99: Greece 325; Italy 75; Knossos
 346
 farmer-colonists 359
 farmers 79, 157, 325, 327, 408
 field systems 375
 forager-farmer interactions 354
 gazelle 123
 Haua Fteah 298: Barbary sheep 284
 herders 9
 houses 355, 371
 ideology 38
 Late 101, 351
 Mehrgarh 162
 Middle 368
 migrant farmers 390
 North Africa 278
 occupation 161
 package 364, 366, 378, 390, 406
 people 8
 pottery 217, 223
 Revolution 9–17, 24
 seagoing farmers 335
 settlement(s) 81, 82, 86, 350, 321
 sites 30: Greece 91; Balkans 353; Britain
 371; Egypt 293; India 176; tell 80
 skeletons 95, 96
 societies 39
 southern, cultivation 178

- Neolithic (*cont.*)
 theism 412
 trackway 376
 villages 134
- Nepali language 101
- net(s) 134, 139, 339
 bird 286
 enclosures 125
 fishing 76, 112, 151, 207, 289, 305, 337, 343: floats 244; sinkers 201: *see also* fishing equipment
 hunting 128
 weights 353
- Netherlands 343, 357, 368
- Netiv Hagdud 105, 131–2, 133
- New Archaeology 26–9, 33
- New Guinea 33, 64, 182, 218, 222, 387, 398
 agricultural prehistory 221
 archaeology 217
 axe 209
 coastal 224
 domestic pig 186
 Highlands 206, 217, 221
 swamp cultivation 219, 220
- New Ireland 209, 210, 222, 223, 345
- New World 16, 22, 74, 145
 agriculture 35
 plant domestication 25
- New Zealand 217, 227
- Newt Kash 243, 244
 caves 232
- Newton, Isaac 57
- Nfusi 274
- Ngarrindjeri 43
- Ngaua 224
- Ngovo 274, 312
- Nia 43
- Niah Cave 95, 183, 206, 207, 208, 209, 213, 223, 224
 plant remains 85
- Nicaragua 231
- Nicotiana rustica* 244
- Niger 275, 299, 313
 delta 310
- Niger-Congo languages 99, 102, 279, 279
- Nigeria 280, 308
- Nile 11, 13, 104, 292, 310
 civilizations 278
 delta 109, 286
 flooding cycle 276–7, 289, 389
- populations 300
 region 279, 306
 silts 276
 transitions to farming 288–94
 tubers 286
 valley 24, 83, 98, 275, 280, 285, 299, 321, 399
- Nile perch 289, 305
- nilgai 151, 160, 165, 172
- Nilo-Saharan
 languages 99, 279, 279, 322
 people 281
- Nilotic cattle-herders 324
- Nilsson, Sven 9
- nine-banded armadillo 241, 258
- Nishida 183, 203
- nitrogen 96
 isotopes 94–5, 270
- Niukh 43
- Nkang 274, 312, 313, 389
 potsherd, 313
- nomadism 6
- nomads 29, 62, 77
- Nombe 183
- Non Nok Tha 183
- Non Pa Wai 215
- non-geometric microlithic industry 155
- noog, Africa 281
- North Africa
 climate 283, 288
 colonization from 310
 diversification 402
 Holocene transition 412
 languages 280, 321
 plant exploitation 397
 radiocarbon dates 24
 sedentary communities 389
 sheep and goats 300: Barbary sheep 393
 sorghum 282, 294
see also under names of individual countries
- North America(n) 232, 413
 archaeologists 18
 coastal 56, 235
 domestication 2
 eastern 93
 eastern Woodlands 231, 245, 388, 398, 399, 404
 floodplain weeds 393
 foragers/foraging 42, 71, 227, 239–46, 402

- gourds and squash 244
Great Basin 53, 61
Great Lakes 231, 246: region 250
horse 401
horticulture 290
languages 236
nitrogen ratios 95
pastoralism 9
plains, kill-sites 238
semi-sedentary societies 49
social structures 45
tundra 66–9
woodlands 65
see also Americas; Canada; American South-West; United States
North Sea 332
Northern Flint maize 250
Norway 68
Norway rat, domestication 394
Noyen 326, 339
Nqoma 317
Ntereso 274, 312
Ntsitsana 274, 316, 317
Nubia(n) 306 313
 people 307
 relief carving 394
 skull 307
Nuer 277
Nukak 71
Nunamiut 66, 68, 71
 reindeer-hunters 48
 territory 67
nut(s) 87
 Africa 294, 312
 Americas 242, 250
 Central and South Asia 151
 East and South-East Asia 199, 208, 213, 223
 Europe 334, 346, 350, 377
 grinding 123
 oil-bearing 322
 pinyon pine 53
 South-West Asia 27, 120, 121,
 134
 nut-grass 285, 292, 293, 389
 tubers 286
 nutrition(al) 92, 307
 stress 383
Nxai Nxai 274
nycteutes 197
Nymphaea 306
oak 245, 332, 334
 trees 62, 129
 woodland 105, 117
oases 12, 14, 277, 383
oasis hypothesis 9–17, 18, 19
oats 31, 115, 149, 336
Oaxaca 232, 252, 410
 valley 251, 253
obligation 310
Obobogo 274, 312
obsidian 142, 203, 225, 246, 261, 335
oca 264
ocean 47
 -floor cores 209
 -floor sediments 79
ochre 75, 213, 283, 306, 343
 red 407, 408
Odocoileus virginianus 239
Oenocarpus palms 263
Oenocarpus bataua 71
Øgarde 326, 365
Ogooué valley 312
Ohalo 105 125
 II 111, 112, 114, 117, 126
 plants 115
oil palm 281, 309, 311, 312, 389
Ojibwa 65
Ojibwa-Chippewa 66
Okala 274
Okanda 312
Okavango Delta 317
Okiek 43
okra 282
Oksapmin 70
Ølby Lyng 326, 343
Old Testament 8
 societies 410
Old World 18, 22, 108
 prehistory 9
Olea europaea 115
Olenii Ostrov 326, 343, 344, 345
olives 113, 115, 276, 352
Olmec polity 261
Olsen-Chubbs 232, 238
Oman 171, 386
onagers 20, 31, 109, 120, 130, 136, 140
Oncorhynchus keta 201
Oncorhynchus masou 201
onion 242
 bulbs 250
opal eye 201

optimal foraging theory 51–3, 51
Opuntia 237
 oracle bones 189
 Orange river 288
 oranges 52
 Ordrup Mose bog 79
 organic remains, microscopic 77,
 79–81
 Original Affluent Societies 55, 56, 72
 Orinoco lowlands 233
 Orkney 372
 Neolithic house 371
 ornaments 2, 91, 283, 343, 407–8
 Oronsay 326, 341
 oryx 98
Oryza glaberrima 277
Oryza nivara 186
Oryza rufipogon 153, 186
Oryza sativa 84, 149, 152, 185
 ssp. *japonica* 185, 186
 ssp. *javanica* 185
 ssp. *indica* 150, 186
 ssp. *sinica* 185
 see also rice
 ostrich(es) 393
 in art 302, 394
 eggs 288: shell 300
 Otsubo 183
 otter 334
 Oued Chebi 274, 309
 Oumm ez Zoueitina, statuette 127
 ouses 132
 ovens 82, 111, 225, 226, 248, 254,
 355
 over-exploitation 411
 ovicaprids 295
Ovis ammon 155
Ovis aries 106
Ovis orientalis 106, 155
 Owens valley 61
 ownership 63
 ox, wild 5, 20
Oxalis tuberosa 264
 oxbow lakes 242
 oxygen isotope analysis 79, 91
 oysters 369
 Ozark rock shelters 232, 245

Pa Sangar 105, 114
 paca 52, 241
 pacae/pacay 264, 267, 268

Pacific Ocean 16, 98, 231, 241, 387
 coast 235: foraging 267–8
 farmers 227
 islanders 225
 littoral 233
 region 217
 packing threshold 400
 paddle and anvil technique 212
 paddles 197, 201
 Star Carr 338
 paddy fields 198, 204, 205
 farming 387
 systems 149
 see also rice
 Padina 326, 340
 painting(s)
 designs 99
 Egypt 304
 on walls 319
 see also rock art
 Paiute 61
 Pakistan 24, 106, 149, 175, 176, 384, 385
 littoral 171
 palaeochannel 218
 palaeoecological studies 259
 palaeoeconomy 29–33
 school 31
 palaeoenvironment 352
 data 195
 Palaeoindian
 bison kill-sites 238
 sites 240
 Palaeolithic 4, 39
 culture 412
 hunters 5, 6
 populations 25–6
 subsistence 331
 Upper: 56, 97, 110; cave art 45
 palaeosols 190
 Palestine 22, 24, 104, 116, 306
 palisades, burnt 372
 Paliyan 43
 palm(s) 213, 237, 258, 263, 266
 cabbage 213
 fibre 52
 fruit 52
 heart 52
 larvae 52
 pith 213
 trees in rock art 302
 Paloma 232, 267

- palstaves 5
 palynology 36, 81
 record 357
Pampa de las Llamas-Moxeke 232, 268
pampas 233, 236
 Pamwak 183, 225
 Panakiwuk 183, 225
 Panalaucá 232, 268, 269
 Panama 231, 239, 258, 259, 261
 phytoliths and charcoal 260
Pandanus sp. 209, 222
 nuts 225
 woodland 61
 pangolin 164
Panicum 290, 295
Panicum decompositum 60
Panicum miliaceum 152, 185
Panicum sumatrense 152, 169
 papaya 64, 234
 paper mulberry 202
 Papua New Guinea 69–70, 209: *see also*
 New Guinea
 Papuan languages 218
Papuana beetle 218
 Paraguay 52
 foragers 57
paramo 233, 236
 Paramó da Peña Negra 232, 263
 parasites 393
 eggs 92
 intestinal 401, 401
 parching 61, 249
 parenchyma 85, 208, 223, 258, 261
 Paris basin 357, 368
 Parita Bay 258
 park woodland 117, 118, 128
 parklands 210, 332
 parrot fish 201
 parsnips 110
 Paso de la Amada 261
Paspalum scrobiculatum 152
 Passamaquoddy Bay 232, 251
 Passo di Corvo 326, 350
 Pastoral Neolithic 314
 pastoralism 6, 8, 9, 44, 99, 175, 176, 389,
 410
 Africa 276–8
 long-distance patterns 361
 mountains 299
 Sahara 294–304
 Sahel 305–10
 transhumant 178, 352
 see also agro-pastoralism
 pastoralist(s) 57, 72, 77, 151
 rock art 301, 302
 societies 154
 pastures 78, 81
 patrilocality 54
 Payne, Sebastian 91
 Pazyryk 92
 PCR, *see* Polymerase Chain Reaction
 Pea Bullock 183
 peach palm 234, 257
 peaches 175, 194, 202, 204
 peanuts 234, 257, 263, 264, 266, 267,
 268
 pearl millet 150, 152, 277, 309, 316, 317
 pears 110, 204, 334, 346
 Pearsall, Deborah 255, 258, 259, 262, 264
 peas
 domesticated: Africa 292, 293; Central
 and South Asia 151, 152,
 172; East and South-East Asia 204,
 212; Europe 350, 359; South-West
 Asia 134, 139
 wild 106, 135
 peccaries 52, 258, 261, 262
 Pedra Furada 232, 236
 peelers 226
Peiligang 183, 192
 farmers 194
 settlement 195
 sites 199
 tools 193
 Peloponnese 335
Peña Roja 232, 263
 Penan 43, 44, 63, 207, 208
 foragers 64
 pendants 160, 407
 amber 408
Pengtoushan 183, 191, 192, 194, 195
 Pennines 342
 penning 199
Pennisetum millet 178, 308
Pennisetum glaucum 152
 pens 292
 pepo squash 242, 244, 251
 pepper 264
 perch 289, 305
 perilla 203
Perilla frutescens 204
 Perkins, Dexter 154–5

- permafrost 92
Persea americana 22, 234, 264
 Persia(n) 11
 Gulf 104, 171
 language 101
 persimmon 204, 242
 Peru 268
 Ayacucho basin 22, 236
 camelid domestication 269
 coastal 253, 267, 399
 crops 257
 forager camps 263
 isotopic values 270
 Jivoroan people 59
 maize farming 24
 mummies 92
 northern 265
 Pacific littoral 233
 plant cultivation 262, 266
 settlements 265
 pestles 111, 113, 116, 119, 121, 122, 134,
 157
Petapilla 259
phalanger 222
Phalanger orientalis 209
Phalaris 135
Phalaris caroliniana 241
Phanourios minutus 335
 pharaohs 302
 Pharaonic
 civilization 321
 Egypt 325
 state 293
Phaseolus sp. 31, 264
Phaseolus adenantha 213
Phaseolus lathyroides 213
Phaseolus lunatus 234, 256, 257
Phaseolus vulgaris 234, 256, 257
 pheasant 31
 Philippines 102, 182, 206, 217, 224, 226
 Phillipson, David 281
 philosophy 57
Phoenix 299
Phoenix dactylifera 160
 phosphate 81
 levels 77
 photosynthesis 397, 398
 Phung Nguyen 215
 phytoliths 76, 79, 85, 92, 255
 banana 219, 277, 312, 313
 evidence for clearance 227, 238
 maize 259, 263, 264
 palm 258
 profile, Lake La Yeguada 260
 rice 169, 174, 186, 187, 190, 191, 200,
 204
 roots and tubers 388
 squash 258, 262
 pickleweed 53
 picks 132
 pictograms 136
 pigeonpea 151, 152, 169
 pigments 114, 165
 pig(s) 5
 burial 216
 domesticated 1, 31, 96, 97: Africa: Nile
 Valley 292, 293: Central and South
 Asia 16: East and South-East Asia
 217: China 189, 190, 194, 198; Lapita
 226, 387; New Guinea 64, 65, 222;
 Peiligan sites 199; Solomons 225:
 Europe 378, 379: Almeria 352; Britain
 and Ireland 370; Ertebølle 345; Greece
 346; Italy 350; TRB 367: South-West
 Asia 106, 108, 141: Iraq 21; PPNA 136;
 Zagros region 137
 jaws 88
 parasites 401
 pre-adaptation to domestication
 403
 wild: Central and South Asia 153: Iran
 20: East and South-East Asia 186, 226:
 Ban Chiang 216; Borneo 63, 407;
 China 185, 187; Niah Cave 207; Spirit
 Cave 212; Thai/Malay peninsula 213:
 Europe 345: Greece 335; Iron Gates
 340; Star Carr 338: South-West Asia
 106: Iraq 114; PPNA 135, 136; Zagros
 region 130, 137: *see also* boar
 pike 334, 353
 Pikimachay cave 236, 240
 pillars 136
 stone 132
 pine forests 332, 360
 pine marten 334
 pineapple 31, 234
 Pintupi 43
 Pinus monophylla 53
 pinyon pine 53, 61
 nuts 247, 252
 Piperno, Dolores 255, 258, 259, 262,
 264

- Pirak 150, 173, 174
 pistachio(s) 113, 115, 134, 136, 336, 346,
 348
Pistacia atlantica 115, 122
Pistacia khinjuk 122
Pisum sativum 152
 pit(s)
 complexes 348
 grave 373
 houses 199, 203
 LBK 357, 358, 359
 mortuary 245
 rubbish 89, 90, 126, 201, 218
 storage 128, 138: Americas 248, 249; Bat
 Cave 247; bell-shaped 290; Chulmun
 199; granary 292; Huanghe valley 192;
 Jomon 203, 203; Lapita 226; millet
 194; Nenumbo 225; seeds 35, 61;
 Yangzi valley 191
 places, pre-adaptation to domestication
 403–5
 Plains 43
 Plains Indians 237, 401
 plaintains 277
 planning 48
 plant(s) 22, 46, 82–7, 84, 350
 Abu Hureyra 122
 cultivation 1, 6, 15, 22, 72, 160, 396, 404:
see also agriculture; harvesting
 domesticated 317
 fibres 22, 76
 foods 110
 Formative sites 266
 gathering 76, 336
 horticulture 397
 husbandry 197, 235, 316, 336, 402
 Indus valley 172
 migration 383
 pre-adaptation to domestication
 403–5
 processing 288
 residues 3
 wild 106, 151, 160
 *see also under names of individual
 species*
 plaque 93
 plaster
 figurines 143
 hut floors 168
 platform, living 338
 plaza 265
- Pleistocene
 Africa 285, 389: landscape 310
 Americas 235
 animals 30
 carbon isotopes 95
 clearance 218
 climate 12, 237, 283, 332, 397, 403:
 change 73, 79; temperature rise 1
 cultivation 221, 388, 398
 disturbance horizon 260
 environment 88
 Europe 328: Greece 335
 Fertile Crescent 19
 foragers 186, 205–10, 239, 260,
 411
 forest manipulation 217
 glaciers 16
 –Holocene transition 27, 32, 109, 146,
 384–5, 402, 413
 hunter-gatherers 39
 hunting 379
 Ice Ages 79
 landscape 333
 Late 14, 39, 42, 162, 116, 221: Africa
 283–8; East Asia 187–8; foragers 27;
 New Ireland 222; settlement 154–5,
 328; wild animals 153
 linguistic dates 236
 population increase 93
 rainforest foraging 205–10
 theism 410
 tundra 334
 vegetation 334
 plough(s)/ploughing 76, 98, 145, 185, 216,
 356, 357, 368
 marks 374
 plums 136, 204, 334
 pluvials 283
 Poaceae, *see* Gramineae
 pods 151
 points
 barbed 122
 bone 197
 pressure-flaked 156
 poison 51, 151, 208, 212
 Poland 360, 363
 polar front 332
 pole and thatch houses 265
 pole-axing 329
 politics 318, 324
 pollarding 87

- pollen
 Americas 246, 255, 258, 261
 analysis 19, 79, 85, 286
 bean 187
 cereal 364
 core studies 332
 diagrams 117: China 190; Korea 200;
 Kuk 220; Yayoi period 204; Zagros
 region 130
 evidence of: burning 354; clearance 223,
 239, 317; grassland 165
 in faeces 92, 298
 maize 251, 252, 263, 265, 267
 oil palm 312
 records 18, 210
 rice 191
 sites 81
 squash 267
 tubers 265
 zones 334
- Polygonum* 121, 290, 292
Polygonum corrigioloides 122
Polygonum erectum 241
 Polymerase Chain Reaction 97
 Polynesia, eastern 227
Pomadasys hasta 171
Pometia pinnata 225
 poppies 110, 359
 population
 densities 47, 70, 414
 estimates 400
 growth 27, 32, 287, 369, 383, 398–401,
 402, 410, 411
 histories 3, 73, 391
 increase 10, 248, 265
 levels 394
 Maya 261
 movements 24, 323, 390
 Natufian 128
 packing 328
 pressure 29–33, 36, 383: hypothesis 33
 replacement 408
 simulations 57
 size 111
 stress 26: models 33
 system 28
- porcupines 151, 207, 212, 299
 in rock art 166
- porphyry palettes 306
- porpoises 201, 334
- porridge 129, 307, 378
- Port au Choix 241
- Portugal 93, 96, 343, 351
- positive feedback mechanisms 27
- postglacial
 desiccation 14, 19
 hunter-gatherer culture 10
- post-holes 90, 218, 219, 225
- post-LGM flooding 398
- Post-Processual Archaeology 33, 40
- potatoes 1, 234, 263, 264, 268, 269
- potions 2, 45
- potter's anvil 214
- potteries 45
- pottery 74, 131, 216, 405
 Africa 290, 293, 295, 320: Cameroon
 277, 311, 312; Cape region 316; Iron
 Age 390; Oued Chebi 309;
 proto-Bantu speakers 281; Sahara 294;
Steinplatz 301; Tadrart Acacus 299;
 West 313, 314, 322
- Americas: Aguadulce 259; Amazon basin
 263; North 249
- breakage, deliberate 319
- brewing 145
- burnished black 189
- Central and South Asia 153: Deccan 178;
 Ganga settlements 170; Ghar-i-Mar
 156; Jeitun 158
- cooking residues 250
- cord-impressed 169, 200
- decorated 246: maize 265; painted 349,
 353; wavy-line 295, 306
- East and South-East Asia 215, 217:
 China 187, 188, 190; Hemudu 197;
 Lapita 224, 226; Sannai Maruyama
 203; Spirit Cave 212
- Europe 78, 325, 327, 328, 345, 366:
 Corfu 349; England 373; Greece 353;
 Iron Gates 356; LBK 358, 358, 363,
 365; Paris basin 368; Windmill Hill
 378
- fillers 85
- kilns 192
- link wth cereal types 406
- making 13, 45, 191, 280, 290, 293
- Neolithic 4, 15, 23, 217, 316, 350: Early
 327, 367
- perforated sherds 305
- plant impressions 312: rice inclusions
 223; seeds 308
- point-based 343

- rice-tempered 176
sieves 359
slow wheel 199
South-West Asia 144
wheel-made 154, 167: painted 177
- pounding 65
tools 113, 132, 156, 210
- power 146
- PPNA, *see* Pre-Pottery Neolithic A
- PPNB, *see* Pre-Pottery Neolithic B
- prairies 231, 235
- pre-adaptation to domestication 403–5
- Pre-Boreal phase 338
- precious stones 171
- pre-Columbian states 388
- predation 411
- pre-Dynastic
chiefdoms 321
societies 293
- prehistorians, Victorian 5, 6
- pre-LBK foraging communities 361
- Pre-Pottery Neolithic 21, 123, 154
- Pre-Pottery Neolithic A 131–7, 384, 410
sites 161
structures 133
wheat/barley cultivators 192
- Pre-Pottery Neolithic B 131, 384
communities 137–46, 192
farmers 157, 280, 292, 321, 385, 386, 389
houses 138, 138, 144
migration 322
settlements 325
villages 147, 300, 383, 399, 409
- preservation techniques 65
- pressure flaking 139
- prestige
Bantu 278
commodities 178
exotic plants 388
food surplus 369
forager societies 54, 336, 405
goods 246, 254, 357, 366, 366, 388
hunter-gatherer 36
hunting 340
ideology of 302
livestock as source of 146, 304, 317, 336,
348, 387, 405
modern pastoralist societies 304
- Natufian 129
- PPNB 146
- trade 368
- prey specialization 331
prickly pear 237, 242
seeds 250
- priests 1, 171
- primates 207
- primitive communism 54
- Princess Point 232
- process 394–7
- Processual Archaeology 26
- Processualists 40
- productivity 47
- progenitors 106
- projectile points 236, 283, 290
- Prolagus sardus* 335
- Prolonged Drift 274, 314, 315,
316
- property 55
- proso millet 150, 152
- Prosopis* 122
- Prosopis juliflora* 237
- protein 33, 95, 145, 263
animal 213
- proto-Asiatic speakers 292
- proto-Austronesian
language 102: spread 388
population 217
- proto-Bantu 280, 390
colonists 323
speakers 281
- proto-Benue-Congo 311
- proto-Central Sudanic 281
- proto-Cushites 281
- proto-Dravidian 167
- proto-herding 137, 331
- proto-Indo-European languages 101, 101,
408
speakers 391
- proto-languages 279
- Proyecto Santa María 232, 258
- pruning 35, 352
- Psidium guajava* 234, 264
- psychology 414
- public
architecture 261
buildings 170
ceremony 254
spaces 248
- Pueblo Bonito 232, 248
- Puglia 349
- pull models 36, 37, 381, 388
- pulque 252

- pulses
 Africa 316
 Americas 234
 Central and South Asia 149: Deccan 176;
 Harappa 174, 177; India 151, 153, 167,
 386; Indus valley 172
 South-West Asia: PPNB 139
 see also under names of individual species
- pumpkin 234
 seeds 22
- puna* 233
- Punan, *see* Penan
- punctuated explosive dispersal 386
- puparia 81
- Puripica 232, 269
- Purron 20
- push models 36, 37, 381, 388
- pygmy elephant 335
- pygmy foragers 63
- python 305
- qanats* 277
- Qasr Ibrim 274, 293
- Qermez Dereh 105, 132, 136
- quail 62
- quarries 371
- quartz tools 311
- Quercus* 115
- querns 45 113, 122, 123, 134, 139, 156
- Quetta 159, 384
- quinoa 234, 263, 264, 266, 269
 isotopic studies 270
- quivers 139
- rabbit(s) 31, 62, 122, 237, 242, 251, 262,
 290
 drives 252
 fur robes 247
- rabi* crops 149, 175, 167, 171
- racial
 superiority 10
 types 92
- racoons 258
- radiocarbon dates 17, 25, 83
 Africa 278
 Americas 252
 Central and South Asia 154, 156, 159,
 164
 chronologies 372
- East and South-East Asia 187,
 189
- Europe 325
 South-West Asia 109
- raids 56
- rainfall
 Africa 283, 286, 289, 294, 308, 316
 Americas 248, 268
 Central and South Asia 157
 South-West Asia 104–5, 135
- rainforest(s) 44, 47, 52, 96, 231, 402
 African 275, 389: transitions to farming
 310–14
- East and South-East Asia 214: China 184
 expansion 212
- foraging 205–10: groups 397
- rain-making ceremonies 302
- Rajasthan 150, 175
 coastal 171
- Rakhigarhi 150, 170
- random genetic kicks 383
- Rangpur 150, 174
- rank 129
- ranking 253, 405
- Ranunculus ficaria* 341
- Ras Shamra 14
- rates of return, declining 411
- rationality 57
- rats 120, 213, 258, 393
- rattles 388
 magical 244
- Real Alto 232, 265
- reaping knives 204
- reciprocity 46
- red beans 202
- red deer 5, 92
 Africa 393
 Americas: northern 237
 antlers 344: Star Carr 338
 Central and South Asia: Ghar-i-Asp 155;
 Ghar-i-Mar 156
 domestication 397
- East and South-East Asia: Chulmun 199
 Europe 32, 330, 345, 334: Denmark 339;
 England 342; Greece 335; Italy 350;
 Netherlands 343; Scotland 68, 331,
 395; Wales 401
- South-West Asia: Levantine corridor
 120; PPNA 135; Shanidar 114; Zagros
 region 130
- teeth 407
- Red river 231
- Red Sea 129, 142, 275, 282

- reed rat 305
 reeds 75, 132, 334
 refugia 285, 328, 384
 refuse 112
 reindeer 5
 herding 68, 69, 136, 235, 331, 403
 hunting 32, 45, 48, 66, 329, 330, 394, 398
 see also caribou
 relict populations 30
 religion 414: *see also* belief systems; ritual(s)
 Remote Oceania 182, 185
 farming 224–7
 Remote Pacific 218
 remoteness 42
 Renaissance Italy 74
 Renfrew, Colin 101, 327
 reproduction 410
 reptiles 223, 259
 Republic of South Africa 275, 324
 rescue excavation 360
 resin 75
 resource(s) 53
 concentration 383
 management behaviours 345
 movement 386
 pressure 383
 revetments, stone 372
 Rhine 329, 365
 delta region 368
 -Meuse delta 341
 rhinoceros 169, 184, 185, 197, 210, 213, 305
 rhizomes 65, 83, 151
 Rhône valley 363
 Rhum 331
 red deer 395
 ribbon 199
 rice 1, 63
 carbon isotopes 95
 carbonized 170, 192
 domesticated 11: Africa 277, 282, 310:
 Central and South Asia 149, 152;
 Ganga valley 170–75; Indus valley
 170–75: East and South-East Asia 82,
 84, 182–230, 385, 405; China 24, 185,
 194, 195, 204; Hemudu 197; Khok
 Phanom Di 215; Korea 199, 387;
 Sarawak 223; Spirit Cave 212; Sulawesi
 224
 fields 176, 205, 214: *see also* paddy fields
 horticulture 174
 husks 83; impressions 215
 modern 198
 phytoliths 200, 214
 spread 387
 stalks 169
 wild 86, 195: Americas 66, 250: Central
 and South Asia 153, 164; Ganga valley
 168, 386; Lekhahia 169: East and
 South-East Asia: Banyan Cave 213;
 China 185, 188, 190, 387
 see also under names of individual species
Ricinus communis 152
 riding 352
 Rindos, David 35
 ring ditch 373
 Ringkloster 326
 rings 160
 bone 366
 stone 305, 309
 Rio Canaguá 232, 267
 Rio Grande 247
 Río Pedregal 232, 240
 rites of passage 145, 293, 376
 ritual(s) 383
 Aboriginal 59
 activities 89
 alcohol 406
 Americas 265
 behaviour 98, 254
 burial 87, 374
 calendrical 409
 cattle 141, 375
 celestial 410
 deposition 372
 Europe 99, 374, 378; trackways 376
 healing 319
 killing 363
 monuments 368
 mortuary 246, 251
 in rock art 302
 San 302
 shaman 345
 South-West Asia 99: PPNA 147
 structures 136, 143, 199
 see also belief systems; religion
 river(s) 404
 animals 294
 gravels 4
 pebbles, flaked 210
 resources 399
 -side plants 285

- river(s) (*cont.*)
 terrace studies 79
 valleys 16
- roan deer 305
- roasting 63, 65, 82, 112, 121, 144
- robes 247
- rock art 248, 340
 carvings 68, 69, 345
 Europe 329
 Lepenski Vir 410
 Mesolithic 166
 Namibia 320
 Nubia 394
 paintings 165
 Sahara 100, 301, 301, 302, 303, 304
 Sahel 310
 San 302, 304
 South Africa 319
 see also carving; engraving; painting
- rock bream 201
- rock shelters
 Africa 302, 319: Cameroon 287, 311;
 Ethiopia 287; Godebra 310; Lesotho
 288; Libya 297
- Americas 239, 258
- Central and South Asia: Ghagharia 164
- East and South-East Asia 210: islands
 223; Japan 200; Thailand 212
- Europe: France 331; Greece 330
- South-West Asia: Zagros region 130
 see also cave(s)
- Rockies 61, 231, 235, 237
- rodents 91, 237, 242, 251, 252, 261, 268
 Tadrart Acacus 297
- roe deer 110, 120, 135, 331, 350, 401
 Star Carr 338
- Romania 340, 353
- root(s) 75, 86, 165, 239, 340, 377
 Americas 388
 crops 16, 85, 185, 212, 255, 316; Africa
 25
 farming 226
 foods 110
 manipulation 322
 tubers 109
 vegetables 83
- rope traps 301
- Rosh Horesha 105, 121, 128
- Rosh Zin 105, 118, 128
- Round Head style 302
- Rousseau, Jean-Jacques 44
- Rowley-Conwy, Peter 392
- royal tombs 310
- rugs 234
- Rukiga highlands 274, 317
- Rumex* 290, 292
- runnels 218
- Russia
 central plain 328
 Stalinism 10
- Rwanda 313, 324
- rye 110, 118
 wild 122
- Sabah 223
- sabre-toothed tiger 4
- Sabz 20
- Saccharum officinarum* 152, 185
- Saccharum robustum* 185
- sacrifice(s) 318, 367, 372
 human 376
- saddle querns 94, 121
- Sado 337
 estuary 326
- Saggai 305
 I 274
- sago 185, 209, 222, 224
 palm 85, 208, 226
 starch 63, 64
 trees 207
- Sahara 275, 283, 295, 308
 Barbary sheep 397, 405
 cattle 299
 cave art 99
 climate change 289, 321, 398
 Eurasian system 145
 foraging to pastoralism 294–304
 languages 279
 migration to 24
 oases 277
 PPNB farmers 280, 389
 rock art 100, 301, 301, 302, 303, 304
- Sahel 275, 295
 climate change 321
 flora and fauna 294: cereal staples 277;
 sorghum, wild 291
- foraging to pastoralism 305–10, 404
- metallurgy 313
- migration to 278, 389
- PPNB farmers 280
- Proto-Cushites 281
- sedentism 398

- Sahlins, Marshall 46, 55, 72
sailing 235, 335, 370, 371
sainfoins 110
saithe fishing 341
Saiyolof 70
Sakuзи 274, 312
Salabiya I 123
salmon 66, 199, 201, 339, 343
 fishing 40
salsify 110
salt 63
 lake 154
Salt river 249
Saltbaek Vig 326, 367, 369
Salts Cave 232, 243, 244
sambar deer 164, 165, 212
Sambucus 204
Sámi 68, 69, 136
San Bushmen 29, 42, 48, 55, 56, 57, 62,
 98
 foragers 279
 rock art 302, 304
 see also !Kung San
San Isidro 232, 262
San José Mogote 232, 254
San Marco 326, 350
sand seas 275
sanitation 57
Sannai Maruyama 183, 203, 204
Sansis 151
Sanskrit 101
Santa Elena peninsula 232, 262
Santhli 171
sapotes 266
Saqqara 98
Sarai Nahar Rai 150, 164, 168, 170
 faunal remains 169
Sabah 64, 95, 223, 406–7
Sardinia 335
Sarurab 274, 305
Sauer, Carl 16
Sauzalito 232, 263
savage 44
savagery 10
savannah(s) 47, 102, 231, 237, 260, 275,
 298
 animals 294
 birds 306
 East Africa 277
 game 314
 scrub 289
 -woodland 275
 zone 309
sawa millet 150, 152
SBK culture, *see Stichbandkeramik culture*
scad mackerel 201
scale 394–7
Scandinavia 339, 343, 364, 365, 367, 368,
 369, 370, 372
Scania 339, 343, 365, 367
scanning electron microscope 85
scapulae bones, water buffalo 197
scheduling conflicts 383
Schela Cladovei 326, 340
Schelde estuary 368
Schleicher, Augustus 99, 101
Schroda 274, 317
Schultz 232
science 57
Science in Archaeology 17
Scirpus sp. 285, 290
Sciurus granatensis 241
Scotland 68, 331, 341, 370, 371, 372,
 377
 red deer 395
Scottsbluff 232, 237
Scowlitz 232, 251
scrapers 74, 114, 122, 139, 203, 226
scribes 306
Scriptures 8
scrub 231, 237, 260, 275
Scythia(n)
 steppes 9
 warriors 92
sea
 -bed pollen 81
 -borne exchange 387
 crossings 413
 -faring 225
 fishing 251
 journeys 210
 level 2, 27, 205, 206, 288: fall 202; rise
 283, 332, 333, 337
 mammals 4, 267: hunting 49, 251,
 343
 -scapes, foraging 335–8
Sea of Galilee 111, 114, 115, 129
sea trout 339
seal(s) (artefact) 171
seal(s) (mammal) 201, 241, 341, 343
 fat 366, 366
 lion 201

- season(al)
 fluctuations 334
 growing 47
 movement 29, 290, 361
 seasonality 117, 154, 178
 Sebrn 326, 337
 Second World War 13
 sedentary
 behaviour 295
 communities 345, 389
 farming 396, 397
 foraging 388; sites 251, 354; societies 46, 56, 394, 399
 sedentism 6, 16, 36, 93, 383, 398–401, 410, 411
 Africa: West 314
 Americas 246: Colombia 265; Formative 253; North 56
 Central and South Asia: Ganga valley 169; Ghar-i-Asp 155
 East and South-East Asia 387: China 188
 Europe 381, 391: Britain and Ireland 378; Denmark 369; Greece 337; Iron Gates 356; Scandinavia 368
 South-West Asia 27, 32: Levantine corridor 135; Natufian 146; Zagros region 130, 136
 sedges 285, 290, 292
 sediments 73, 79–81
 water-logged 401
 seed(s) 35, 51, 73
 Australia 63
 charring 82
 -corn 370
 crops 265
 Deccan 151
 foods 110
 gathering 60, 304
 grass 61
 Malay peninsula 213
 marsh 139
 mineralized 308
 -processing equipment 191
 seje 71
 South-West Asia: Natufian 121, 122, 123;
 wild 134; Zagros region 136
 weed 140
 Sehonghong rock shelter 274, 288
 Seine valley 339
 seje 71
 Selevać 326, 357
 self-pollinating 403
 semi-desert 275
 semi-nomadic farming 13
 semi-precious stones 167, 173
 semi-sedentary people, Nile 305
 Semitic languages 280
 Serbia 340, 353
 sesame 152
 Indus valley 172
Sesamum indicum 152
 Sesklo 326, 346
 artefacts 347
Setaria 290, 295 306
 seeds 305
Setaria italica 152, 185
Setaria pumila 152
Setaria verticillata 152, 169, 177, 178
Setaria viridis 185
 settlement(s) 76–8, 126, 177, 265, 358, 368
 Africa: Khartoum 305; South 316, 318; West 287
 alluvial 129
 archaeology 26
 Bronze Age 15
 clustering 246
 defended 351
 East and South-East Asia 223: Jomon 201, 203, 203; Lapita 226
 Europe: Greece 346; LBK 358, 365
 expansion 236
 hierarchy 267, 352
 histories 26
 lakeside 198
 Neolithic 86, 350, 321, 327
 open-air 349
 patterns 27
 Pleistocene, Late 154–5, 328
 South-West Asia: Jarmo 21; Jericho 131; Kebaran 111; Natufian 118, 122; PPNA 142; PPNB 137
 trends, changing 242
 waterlogged 9
 sewing 122
 sexing 96
 animal bones 89
 sexuality 410, 414
 Shabona 306
 shamans 59, 244, 248, 304, 319, 345, 388
 Shang state 189

- Shanghai 195
 Shang-shan 183, 191
 Shanidar 105, 114
 Shao farmers 200
 sharks 201, 334
 Shashe-Limpopo basin 317
 Shaw, Thurston 273
 shea butter 312
 sheep
 in art 99, 100
 burials 87: skulls 310
 domesticated 1, 31, 96, 97: Africa 390:
 Cape 316–17; East 314; Esh Shaheinab
 306; Fayum 293; Khoikhoi 278;
 Merimde 292; Nkang 313; northern
 277; Sahara 300; Sudan 281: Central
 and South Asia 385: Belt Cave 156;
 Deccan 176; Ganga valley 171;
 Harappa 167; Jeitun 158; Mahasati
 168; Mehrgarh 160–62, 161: Europe 4,
 5, 353; Britain and Ireland 370; Greece
 346, 348; Italy 350; TRB 367;
 Windmill Hill 378: South-West Asia
 106, 383; Çatalhöyük 140; Jarmo 21;
 Natufian 146; PPNB 139, 141, 145
 horn cores 88
 pre-adaptation to domestication 403
 remains, excavation of 91
 size 163
 wild 11, 30, 31: Africa 405: Tadrart
 Acacus 299: Americas: South-West
 247: Central and South Asia 153:
 Belan valley 164; Ghar-i-Asp 155; Iran
 20; Jeitun 157; Mehrgarh 160, 161,
 162: Europe 352: Alpine region 336:
 South-West Asia 19, 27, 108, 384:
 Ghar-i-Khar 116; Hindu Kush 155;
 Zagros region 109, 114, 130, 131, 136,
 137
see also under names of individual species
 Sheep Camp Shelter 232, 247
 shell(s) 21, 79, 170, 261, 283, 313, 335
 fish-hooks 306
 jewellery 126: bracelet 160; -disc beads
 214; pendants 160
 knives 214
 marine 142, 167, 246, 313
 middens 91, 200
 mounds 4
 sickle 193
 temper 224
 shellfish 91, 92
 Africa: Kadero 306; Sahara 294
 Americas: Aguadulce 259; Caverna da
 Pedra Pintada 237, 263; eastern
 Woodlands 245; Ecuador 262, 265;
 North 242; Pacific coast 267; Panama
 258
 Australia 62, 63
 Central and South Asia: Sri Lanka 164
 East and South-East Asia: China 187;
 Chulmun 199; Gua Cha 213; Hemudu
 197; Jomon 201, 202; Khok Phanom
 Di 215; Nenumbo 225; Vietnam
 210
 Europe 330: Baltic 369; Ertebølle 342;
 Greece 335, 337; Serbia 353; Spain
 331
 middens 316
 South-West Asia 27
see also under names of individual species
 shelters, Natufian 138: *see also rock shelters*
 shepherd encampment 78
 Shetland 372
 shifting cultivation 218
 Shih-hsia 183
 Shillourokambos 105, 346
 Shimotakabora 183, 201
 Shixia, *see Shih-hsia*
 shoals 242
 shoe-last
 adzes 359
 celts 365
 Shongweni 317
 Shoshone 61
 shredders 75
 shrines 357
 shrubs 185, 298
 Shukbah 105, 116, 129
 Shum Laka 274, 287, 311, 312
 Siberia 87, 235
 Siberian ibex 155
 Sicily 336, 349
 sickle(s) 45, 74, 75, 195
 Africa 291
 blades 111, 122, 139, 350
 Central and South Asia: Ghar-i-Mar 156;
 Jeitun 157; Mehrgarh 162
 East and South-East Asia: Jiahu 194;
 Peiligang 192, 193

- sickle(s) (*cont.*)
 Europe 76, 359
 gloss 285, 287
 haft 127
 metal 321
 South-West Asia 27: Jordan 139;
 Natufian 14, 116, 125, 126; PPNA 134
 Sidari 326, 349
 Sierra Nevada 61, 231
 sieva-type lima bean 257
 sieves/sieving 76, 83, 86, 120, 359
 sika deer 194, 197, 201
 silica 79
 silk weaving 189
 silkworm 189, 199
 silo(s) 27, 77, 82, 136, 138, 157, 174, 177,
 355: *see also* storage
 Silver Leaves 274, 317
 silverseed gourd 234, 257
 simple societies 56
 Sinai 104, 109, 128
 desert 141
 Sindi language 101
 Sinhalese language 101
 Sino-Japanese war 189
 Siriono 43, 63
 Sitagroi 91
 Sittard 326, 357
 Siwa oasis 274
 size diminution 30, 88, 141, 162
 skate 201
 Skateholm 326, 343, 345
 skeletal types 280
 skeleton(s) 94, 111, 160, 194, 250
 chemistry 3
 Europe, central 98
 Jomon 201
 Mesolithic 95, 96
 Neolithic 95, 96: Early 369
 strontium/calcium ratios 125
 skin(s) 87, 151
 working 122
 skull(s) 92, 132, 141, 143, 363
 bull 136
 cap, Star Carr 338
 formation 93
 human 129
 Nubian 307
 sheep and cattle 310
 slabs 122
 slag 313
- slash-and-burn agriculture, *see*
 swiddening
 Slatina 355
 slaves 56
 Slavey Dene 43
 Slavic languages 101, 101
 Slavo-Germanic languages 101
 sleds 331
 sling balls 165
 sloth bear 164
 slow loris 212
 slow wheel 199, 293
 Smilčić 326, 349
 Smith, Bruce 392, 398, 403, 411
 smoking (food) 287, 289, 331
 snails 337
 snake(s) 52, 136, 207, 237, 258
 effigies 345
 Snake Cave 156
 Snake Rock 319, 320
 snares 212: *see also* traps
 snowmobiles 402
 snow-shoes 331
 social
 archaeology 3
 behaviour 368, 414
 boundaries 54
 cohesion 375
 competition 381, 410, 411
 complexity 28
 differentiation 340, 344, 353
 disintegration 26
 elaboration 351, 352
 evolution 412
 exchange 55
 foragers 33–8
 hierarchy 165, 401
 models 37
 norms 406
 organization, animal 403
 relations 405
 storage 348
 stratification 265
 structures 54–6
 societies
 hierarchical 389
 stratified 261
 socio-economic competition 388
 soil(s) 73, 254
 chemistry 125
 fertility 353

- Solanum tuberosum* 234, 264
 soldier rocks 68
 Solomon Islands 182, 209,
 224
 Somerset Levels 326, 376,
 376
 Son 155
 Valley 150, 155, 176
 Son Vi 183
 Sopie 274
 sorghum
 domesticated 1, 405: Africa 82, 277, 281,
 282, 291, 389, 390: Bantu 278, 281;
 Mozambique 316; Nile valley 98;
 Nubia 307; Sahel 305, 321; South 317:
 Central and South Asia 150, 152:
 Harappa 283; Mehrgarh 173
 carbon isotopes 95
caudatum 277
durra 277, 282, 282, 293
guinea 277, 282, 282
 impressions 305
kafir 277, 282, 282
 wild: Africa 290: Egypt 293, 294; Nabta
 Playa 290, 298; Sahara 304
Sorghum bicolor 152, 277, 282, 282, 290,
 291, 293, 306
Sorghum verticilliflorum 282, 306
 Sorori 199
 Soufli Magoula, artefacts 347
 soursop 266, 267
 South Africa 275, 278, 288
 cattle organization 318
 plants 317
 sorghum 277
 transitions to farming 314–20
 for the country see Republic of South
 Africa
 see also under names of individual
 countries
 South America 232
 crop plants 256, 257
 cultivars 264
 domestication 2
 environmental zones 233
 fieldwork difficulties 40
 foragers 42, 71, 397
 manioc 311
 Paleoindian sites 240
 rainforests 52
 roots and tubers 388
 see also under names of individual
 countries
 South Asia 145, 149, 179, 181, 385–6,
 412
 common crops 152: see also under names
 of individual crops
 domestication 162: see also under names
 of individual species
 fieldwork limitations 25
 foragers 164–5
 languages 101
Musa sp. 312
 pastoralism 175
 sites 150
 trade 173
 see also under names of individual
 countries
 South Korea 199
 South Street 373
 barrow 374
 South-East Asia 16, 183, 206, 386–8, 398
 carbon isotopes 95
 farming 182–230: rice 82, 405: see also
 rice
 fieldwork difficulties 41
 food-plant remains 84
 foragers 71
Musa sp. 312, 389
 population-stress model 33
 tubers 397
 vegetation clearance 311, 396
 see also under names of individual
 countries
 South-West Asia 18, 23, 105, 382–5, 397,
 412
 climate 27, 399, 402
 crop farming 82–3: cereals 189; systems
 87
 cultivars 336
 cultivators 192
 domestication 2, 88: see also under names
 of individual species
 farming 27: beginnings 30, 39; spread 25;
 systems 387
 foragers 99
 herding 33
 Neolithic: colonists 378, 405; farmers
 293, 325, 290; settlements 327
 Neolithic Revolution 13
 pastoral ethic 410
 PPNB 346, 389: villages 409

- South-West Asia (*cont.*)
 transitions to farming 104–48
see also under names of individual countries
- Southern Bantu 318
- Southern Hews 70
- sowing 35, 36, 134, 277, 363
- Soya 183
- soybean 1, 204
- spades 76, 192, 193, 194, 197, 198
- Spain 328, 330, 331, 337, 351
 cave art 45
 rise of Fascism 10
- Spanish
 conquest 235
 language 101
- spatulae 122, 295
- spear(s) 63, 74, 151, 197, 207, 286, 305, 331, 339
 fish 201, 343
 -heads 5
see also fishing equipment; harpoons
- specialized domestication 35
- spelt 293
- spikelets 169
- spindle whorls 76, 169, 175, 197, 215, 351
- spiny caper bush 110
- spinning 45, 271
- Spirit Cave 183, 212
- spirits (ancestor) 99, 407
- spirituality 409
- spotted deer 160, 164
- spread 413
 models 278–83
- squash(es) 22, 31, 257, 268, 388
 Central America 251–4: Aguadulce 259;
 Mexico 258
 cultivars 264
 farming 267
 fragments 252
 North America 242, 246, 249: California
 62; Icehouse Bottom 241; Illinois 243;
 Schultz 250
 phytoliths 258, 262
 rainforest 402
 South America: Colombia 265;
 Formative 266; Peru 263
 swidden farming 267
- squirrels 213, 241, 258, 262
- Sri Lanka 151, 164
- St John 232
- stabbing spear 331
- stable isotopes, *see* isotope(s)
- stag, rock art 166
- Stahl, Ann 273
- stake-holes 218, 219
- Stalinism 10
- stalls 73, 77, 78, 82, 176, 198, 298
- stamp seal 173
- stamps, clay 347
- Star Carr 326, 338–9
- Starčevo 326, 353
 culture 354
- starch 255, 285
 grains 76, 85, 208, 209, 258, 259, 263
- Stark, Barbara 36
- states, origins 10
- statuette, limestone 127
- status 254, 317, 344, 378, 406
 differentiation 365
- Steep Cliff Cave 212, 213
- Steinplatze* 301
- steppe(s) 96, 104, 105, 109, 117
 bison 235
 China 184
 -deserts 109, 110, 140
 horse 330
 Scythia 9
 settlement 120
 sites 122
 Tartary 9
 vegetation 105, 187
- stewardship 63
- Stichbandkeramik* culture 363
- stimulants 244
- Stipa* sp. 122
- stock
 corrals 358
 -keeping 6, 175, 192, 278: systems 356
- stomach contents 87
- stone(s) 132, 237
 cairns 66
 cobbles 259, 262
 enclosures 123, 319
 kites 140
 -lined storage pits 290
 phallic structure 118
 pillars 132, 314
 quarries 371
 revetments 372
 structures 135, 298
- technology 122, 156, 168

- stone (artefacts) 5, 76
adzes 191, 197: LBK 358
arrowheads 312
axes 192, 322, 365, 408
blades 158
bowls 111, 127, 156, 162
in burials 246
celts 5, 365
chisel 160
East Asia: Gua Cha 211
Europe: LBK 358
figurines 143
grinders 295
grooved 122, 301, 301, 305
hoes, chert 244
jewellery: bracelet 160; earstuds 347;
 necklaces 168; rings 309
mace-heads 306
mortars 210
North America: Virginia 236
perforated 162, 165, 305
polished 15, 189, 325, 327, 346, 366, 366
quartz 311
reaping knives 204
residues on 85: starch grains 209, 218
sickle 193: sheen 287
traps 62
unifacially flaked 212
weights 191
- Stone Age 4
 hunters 8
- Stonehenge 372
- storage 50, 51, 72, 383, 402
 bins 118, 306
 eastern Woodlands 65
 Europe 345: Bulgaria 86
 fuel 269
 legumes 403
 meat 161
 Natufian 119, 126
 pits, *see* pits, storage
 pottery 188, 197, 263, 305, 406: jar 74;
 point-based 343
 silos, *see* silo(s)
 structures 77, 143, 159, 268, 293:
 granaries 45; Mehrgarh 167
 systems 48
 technology 200
 wild plants 36
- storksbills 110
- strainer sherds 78, 351
- Straits of Hormuz 104, 109
- strandloopers 343
- stratification, social 265, 387
- straw 81, 111, 140, 295
- structures 76–8
 Natufian 119
 Netiv Hagdud 133
 Stukeley, William 374
 Sturdy, Derek 329
 sturgeon 340, 341
 Suaeda fruticosa 122
sub-Arctic hunting territories 48
- Sub-Boreal phase 351, 370
 climate 364, 369, 379
- sub-Saharan Africa 71, 279, 313
- subsistence 1, 2
 activities 3, 76, 311
 Africa 278: Egypt 293; Ethiopia 287
 behaviour 54, 71, 134, 187, 348, 356,
 400
 change 20, 26, 39, 141, 147, 251, 397,
 398, 406
 data 386
 delayed return 126, 345
 determining 17, 87
 East and South-East Asia: Jomon 202,
 203
 Europe 374, 379
 farmers 46, 102, 234, 327
 fishing 308
 forager 42, 44, 50, 141, 327: rainforest
 207
 horticulture 70
 hunter-gatherer 42, 140
 hunting 160, 245: marine foods 241, 387
 and ideology 407–10
 intensification 27, 28, 246, 292, 385,
 399
 Mesolithic 342
 mobility 375
 modes 390
 Palaeolithic 32, 331
 patterns 34, 35, 73
 plant cultivation 199: maize 247
 practices 361
 scheduling 401
 South-West Asia 148: Zarzian 116
 specialization 343
 strategies 47, 52, 195
 systems 49, 120, 128, 265
 substitution phase 364, 368, 379, 380

- Sudan 275, 305, 306
 desert 87
 herders 316
 tribes 34
 Sudanic-speakers 281
 sugar 93, 214
 sugar beet 1
 sugar cane 1, 152, 185, 222, 225,
 226
 Sulawesi 182, 217, 223, 224
 Sumatra 64, 182, 206, 217, 223
 pollen sites 183
 Sumerian(s) 145, 171
 civilization 11
 times 14
 summer squash 257
 sumpweed 239, 244
 Sunda Shelf 210, 398
 sunflowers 241, 243, 244, 247,
 388
 Surkotada 150, 173
 surplus 46, 141
 surrounds 51
Sus barbatus 186, 207, 213
Sus papuensis 186
Sus scrofa 106, 186, 213
Sus scrofa vittatus 186
Sus verrucosus 186
 Swabian uplands 340
 swamp
 cultivation 219, 220
 drainage 261
 swamp deer 160, 168, 169, 185
 swamp taro 209
 swan's wing 344
 Swat 175, 176
 Sweden 68, 339, 365
 sweet chestnut 202
 sweet potato 1, 11, 85
 Americas 234, 257, 258, 264, 267
 East and South-East Asia 70, 185, 220,
 221, 226, 227
 wild progenitors 86
 Sweet Track 376, 376
 swidden(ing) 185, 221, 261, 263, 265, 276,
 325, 396
 agriculture 260, 261
 farming 194, 259, 267, 360
 fields 190
 systems 149
 swiftlets 207
 Swifterbant 326, 368
 Switzerland 361, 369
 lake villages 9
 Neolithic settlement 81, 82
 uplands 329
 swords 5
 symbolic ties 348
 symbolism 144
Synodontis 305
 Syria 36, 110, 121, 384
 artefacts 347
 desert 104, 105
 steppes 108, 118, 135
 western 104
 Syrian pear 110
 syrup 252
Syzygium 178
 taboos 57, 377
 Tadrart Acacus 274, 275, 298
 faunal remains 297
 mountains 294, 295, 296, 304
 Tagra 274
 Tagus 337
 estuary 326
 Tahitian chestnut 225
 Taibe 105, 121
 Taima-Taima 232, 236
 Taiwan 102, 182, 217
 tools 193
 Talagalal 274
 Talara 240
 Talepakemalai 225
 Talheim 326, 363
 Tamaulipas valley 22, 23
 taming 394
 Tangatatu rock shelter 227
 Tanjay 183
 Taoudenni basin 294
 Taperhinja 263, 232
 taphonomy 86
 tapir 241
Tapirus bairdii 241
 taro
 domesticated 70: Americas 258: East and
 South-East Asia 185, 217, 387: Eastern
 Carolinians 225; Kuk 220, 220, 222, 226,
 398; New Guinea 221; Sarawak
 224
 starch grains 85
 swiddens 221

- wild: East and South-East Asia 186, 208, 223: New Guinea 218
- Tartary, steppes 9
- Tasmania 65, 70
- tatar lily 110
- tattoo(s)
- on bodies 92
 - designs 224
- taurine cattle 299, 321
- breeds 164
- Taurus mountains 104, 105
- region 139
- Taviolere plain 349, 350
- sites 326
- Tayassu peccaro* 241
- Tayassu tajacu* 241
- technology 26
- innovation 383
 - iron 102
- tectonic activity 79
- teeth 92, 144, 168, 170, 178, 190, 213
- Barbary sheep* 284
 - calculus 170
 - camelid 269
 - canine 126, 190
 - caries 93, 95, 168, 170, 171, 175
 - cementum bands 120
 - deer 168
 - disease, *see* dental disease
 - eruption 93
 - gazelle 120
 - grizzly bear 246
 - horse 329
 - human 73, 160: Danish 369
 - marks, dog 237
 - Natufian 125
 - Nubian 307
 - occlusal wear 170
 - ornaments 343, 407
 - pig 88, 222
 - reindeer 329
 - sheep 139
 - wear 215, 261, 377
- teff 277, 282, 306
- Africa 281
 - horticulture 310
- Tehuacán 26, 252, 254
- Archaeological Botanical Project 22
 - valley 20, 22, 23, 232, 236, 237, 251
- Telemachay 232, 269
- Tell Abu Hureyra 137
- Tell Aswad 105, 132, 134
- tell(s)
- artefacts 347
 - communities 354, 356
 - dwellings 355
 - Neolithic 80
 - settlements 346
 - Thessaly 349, 351
 - villages 353
- Tell el-Sultan 131, 137
- Tell Hallula, artefacts 347
- temperature 27, 262, 283, 332
- change 117
- tench 334
- Ténéré mountains 299
- teosinte 255, 259
- Tepe Gawra 14
- Tepe Gaz Tavila 150, 173
- Tepe Guran 21
- Tepe Sialk 14
- Tequendama 240
- terebinth nutlets 110
- Terebralia palustris* 171
- Terminalia* 212
- terminology problems 328
- terminus ante quem* 389
- Terra del Fuego 8
- terraces 78, 248, 352
- terrapin 164
- territorial
- behaviour 368, 381, 399
 - ownership 99, 343, 345, 349
- tethered mobility 360, 375, 380, 391
- Téviec 326, 344, 369
- textiles 13, 160, 203
- production 76
 - see also* cloth; fabric
- Thailand 182, 186, 188, 212, 214, 215, 223
- mountains 213
 - Neolithic burial 216
- Thames valley 373
- Thar desert 150, 151, 154, 165, 168
- thatch(ed) 75, 87
- structures 357
- Thatcham 326, 339
- Thayngen Weier 81, 82
- theism 414
- agricultural 410
 - Neolithic 412
- Thessaly 348, 351, 353
- Thomsen, C. J. 4

- Thomson's gazelle 314
 Thora 295
 faunal remains 297
 threads 76
 Three Ages 4, 5
 Three Fir shelter 232, 247
 threshing 61, 86
 throwing spear 331
 Thukela Basin 317
 Thule Eskimo 49, 56
 Tibesti mountains 275, 299
 Tibet 106
 Tibító 232, 236, 240
tierra fría 252
 tiger, rock art 166
 Tigris river 11, 19
 valley 104, 105, 105, 130
 Tikal 232
Tilapia 305
 tillage 35, 126, 134, 135, 191, 263: *see also*
 ploughing
 Tilwara 150, 168
 timber 87, 118, 171
 buildings 196, 371, 372
 posts 357
 production 87
 trackway 376, 376
 Timbisha Shoshone 43
 Timor 217
 Tin-Ouaffadene 274
 Ti-n-Torha 274, 298, 299
 Tisza river 354
 valley 353
 Tjapwurong 70
 Tlingit 65
 Toara cave 224
 tobacco 63, 151, 244
 Tobo 43
 Toé cave 223
 Togolok-depe 150, 157
 Tokyo Bay 201
 tomb(s) 15, 310, 368, 374, 377
 Egypt 98: paintings 304; Tutankhamun
 293
 high status 265
 Tongsamdong 183, 200
 Tonkin 210
 tool(s) 2, 91
 flint 14
 pathologies 227
 waste 372
 see also artefacts; and under names of
 individual tool types and materials
 Torihama 183, 201, 202
 subsistence 202
 Tornillo rock shelter 232, 247
 Torres Strait 43
 tortoises 112, 164, 165, 169, 197, 210, 237,
 288
 totemism 59, 409
Touchardia latifolia 226
 Toutswe 274, 319
 toxicity 239
 toxins 86, 285, 403
 plants 386
 tracks, rock art 331
 trackway, Neolithic 376, 376
 traction 89
 power 171
 trade 13
 acculturation 361
 Africa 313
 Central and South Asia 173
 communities 401
 East and South-East Asia 204, 226
 farming societies 45, 386
 forager societies 42, 202, 207, 214,
 300
 forest products 367
 goats 300, 313
 hunter-gatherer 158
 jasper 351
 long-distance 171
 meat 151
 metal 351
 pastoralist societies 72, 277
 prestige goods 254, 348
 sheep 300, 313, 336
 South-West Asia 141
 see also barter; exchange
 trances 99, 302
 Trang 183
 transhumance 151, 178, 351
 grazing systems 234
 pastoralists 277
 Transvaal 316, 319
 trap(s)/trapping 51, 165
 bird 286
 deadfall 66
 fish 56, 76, 207, 343, 369
 game 65, 212, 331
 rope 301

- stone 62
Tuareg 301
see also net(s)
trauma 95
travois 237
TRB, *see Trichterbeckerkultur*
tree(s)
 bark 329
 crops 234, 265
 fruits 237, 263
 see also under names of individual species
tree cotton 152
Tres Ventanas 269
tribal
 societies 15, 34, 46
 structures 350
Tribe Trifoliae 122
tribute 1
Trichterbeckerkultur 367
 populations 369
Trichuris trichiura 401, 401
Trifolium 292
Trinidad 265
tripod cooking stands 195
Triticum aestivum 152
Triticum aronicum 106
Triticum boeoticum 106, 107, 158
Triticum dicoccoides 107, 115
Triticum dicoccum 106, 152
Triticum monococcum 106
tropical
 cultivation systems 254–61
 environments 49, 231
 foraging 258, 260
 lowlands 254, 258, 266: settlement
 261
 rainforests 62–6, 207, 233, 259: game
 241
 regions 360
trout 201, 343
 fishing 66
Troy 15
truffles 110
trypanosiamis 276
tsetse fly 276, 307, 317
Tsodilo Hills 317
Tuareg 277, 299
 trap 301
tuber(s) 83
 domesticated 85, 86: Africa 288, 388:
 Americas 239, 255, 263, 265: East and
- South-East Asia 185, 397: China 190;
 Lapita 226
isotopic studies 270
manipulation 322
wild 87: Africa 286, 290: Americas 258,
 259, 261: Australia 63, 65: Central
 and South Asia: Eastern Ghats 151:
 East and South-East Asia 386: Malay
 peninsula 213; Niah 223: Europe 340,
 377: South-West Asia: Abu Hureyra
 121
*see also under names of individual
 species*
Tucson 248
 basin 232
Tugela valley 316
Tulán 232, 269
Tulugak Lake 66
 area 67
tumuli 310
Tunanmarca 269
 community 271
tundra 47, 231, 237, 239
 forest 334
 northern 66–9
Tunisia 275
tunny 337
Turkey 21, 24, 104, 109,
 146
 artefacts 347
 einkorn 106
 farming communities 87,
 348
 forests 105
 Neolithic settlements
 346
 north-west 15
 pigs 141
 PPNA 384
 PPNB 137
 south-eastern 108
 wild wheat 29
turkeys 31, 261
Turkmenistan 149, 157, 158, 162, 165, 171,
 385
Turner Farm site 232
turquoise beads 160
Turrialba 232, 240
turtle(s)
 Africa 289: Khartoum 305; Merimde
 292; Sahara 294

- turtle(s) (*cont.*)
 Americas 237: Amazon basin 263; Belize 261; Schultz 250
 Central and South Asia: Iran 21
 East and South-East Asia: China 187;
 Hemudu 197; Jomon 201; Khok Phanom Di 214; Niah 207
 Europe 354
 shell 214
 South-West Asia 27
 Tushka 274, 286
 tusk tools 208
 Tutenkhamun's tomb 293
 Tutsis 324
 Two Caves 298
 Tybrind Vig 326, 339
Typha 299
 Tyua 43
- Uan Afuda 274, 295, 296, 398
 basket fragments 298
 dung 300
 faunal remains 297
 Uan Muhoggiag 274, 299, 302
 faunal remains 297
 Ubuka 202
 Uganda 317
 Ukraine 328, 364
 Ulu Leang cave 224, 223
ulun 407
 Um Direwa 306
 Umm Dabaghish 140
 ungulates 151
 ungulates 134, 299
Unio 286
 United States 231, 235
 Alaska 56, 66, 67, 231, 235: reindeer 48
 Arizona 246, 247: Phoenix 248, 249
 California 62
 Colorado 246, 247, 248
 Florida 243
 Georgia 250
 Hawaii 217, 227
 Illinois 242, 244: squash 243
 Mississippi 235: region 249; valley 231, 239, 242
 Missouri-Arkansas border 245
 New England 251
 New Mexico 22, 237, 246, 248
 New York 250
- Ohio 244: goosefoot 244
 Penobscot Bay 251
 South-Western 388
 Texas 237, 250
 Utah 246
 Virginia 236
 Washington DC 235
see also Americas; American South-West
 Upper Wahgi valley 217
 Urban Revolution 11
 urbanism 400
 civilizations 2
 urial sheep 11, 106, 155, 156, 157
Uruchloa/Brachiaria 298, 298
 use-wear studies 158, 223
Usijiri 183
 Utunur 150, 178
- Vail 232, 237
 Valdivia 264, 266
 Van Vagrins 151
 Vanimo 209, 224
 Vatican 74
 Vavilov, N. I. 18
 crop origins 18
 Vedbaek 326, 343, 408
 burial 344
 Veddas 151
 Vegas culture 263
 vegetable(s) 60, 83
 Indus valley 172
 shredders 75
 stems 111
see also tubers; and under names of individual species
 vegetation 79, 233
 China 184
 Europe 334
 history 81
 Holocene, early 255
 types 404
 zones 332
see also plant(s)
 Venezuela 52, 236, 262, 265, 267
 Vera valley 352
 vetches 121, 135, 139, 350, 359
 Victorians 14, 39, 58, 325, 328, 392
 vicuñas 22, 234
 Vietnam 182, 186, 188, 210, 215, 217
 war 41

- Vigna* sp. 84, 178
Vigna aconitifolia 152
Vigna mungo 152
Vigna radiata 152, 177, 203
Vigna unguiculata 152, 309
 village(s) 13, 45, 77, 157, 249, 254, 259, 353
 aceramic Neolithic 22
 agricultural 165, 293
 Dhar Tichitt 308
 ditched 349
 farming 386
 Greece 346
 Iron Gates 341
 Neolithic 134
 PPNB 147, 300, 383, 399, 409
 Yang-shao 198, 198
 see also hamlet; settlements
 Vinča 326, 356
 Vindhyan 165
 vine(s) 276, 352
 -wood 167, 352, 377
 violence 56, 93, 227, 248, 345, 363, 366: *see also* combat; warfare
 deaths 287
 Vistula 365
Vitellaria paradoxa, *see* *Butyrospermum parkii*
 viticulture 167
Vitis vinifera 115
 Vlasać 326, 340, 356
 vultures 112

 wadi, floors 277
 Wadi Araba rift valley 129, 135
 Wadi Faynan 80, 105, 132
 Wadi Hammeh 27: 105, 118, 120
 Wadi Kubbaniya 83, 274, 285, 286, 287, 321
 tubers 286
 Wadi Madamagh 111
 Wakankar 165
 Wales, parasite 401, 401
 wallaby 209
 Wallace Divide 210
 walls 78
 field 375
 painted 319
 walnuts 175, 194, 200, 202, 202, 247
 walrus 201, 241
 Wangdong Cave, *see* Diaotonghuan Cave
 Wanka, isotopic values 270

 Wanniyala-aetto 43
 wapiti 235
 warfare 17, 45, 170, 351: *see also* combat; violence
 Warlpiri 43
 Warren Field 372
 warriors 1, 171
 ideologies 351
 rock art 302
 warthogs 299
 Tadrart Acacus 297
 warty pig 186
 warty squash 234, 251, 257
 waste products 53
 water
 access 383
 -holes 319
 supplies, 139, 292: Sahara 277
 water buffalo 96, 97
 Central and South Asia 160, 164, 171, 175
 East and South-East Asia 185, 186, 189, 191, 194, 198, 199, 210, 216, 387
 pre-adaptation to domestication 403
 water chestnuts 197, 202, 202, 334
 water deer 190, 194, 197
 water lily 285
 water turtle 210
 waterbuck 305
 watercraft 337: *see also* boats; canoes; kayaks; sailing; seafaring
 waterfowl
 Africa 289, 295
 Americas 242, 259
 Australia 62
 East and South-East Asia 194, 197, 201
 Europe 334, 343, 354: Star Carr 338
 South-West Asia 112, 114
 see also under names of individual species
 waterlily 334
 waterlogged
 conditions 81, 87, 92, 196
 environment 76
 sediments 401
 sites 78
 watermelon 204
 wattle
 and daub 254, 357
 frames 346
 wave of advance model 327, 327, 356, 361, 378, 386, 390

- wealth 45, 146, 254, 306, 344, 390, 406
 weaning 249, 250
 weather 332
 patterns 2, 97, 404
 systems 187
 see also climate
 weaving 45, 189, 215, 271
 shuttles 197
 weed(s)/weeding 35, 36, 46
 cultivation, North America 239–46, 359
 farming, the Americas 231–72
 horticulture 321
 seeds 140
 weights 191, 353
 weirs 62, 343, 369
 wells 63, 292
 wooden-framed 360
 Wendorf, Fred 291, 292
 Wessex 371, 375
 chalk downs 372
 West Africa 278, 288, 412
 landscape 287
 migration from 280
 rainforests 275, 310, 389
 roots and tubers 322
 sorghum 277
 West Bank 108
 West Kennet long barrow 326, 371, 373
 Western Ghats 153
 Westropp, Hodder 4, 5, 8, 29, 40
 wetland
 cultivation 221
 grazing 376
 landscape 195, 308
 margins 218
 wet-rice agriculture 204, 216, 406–7
 whales 49, 241, 334
What Happened in History 9, 13, 15
 wheat
 domesticated 1, 5, 11, 86, 108, 405:
 Africa 276, 278, 389; Nile valley 277;
 Central and South Asia 149, 178:
 Deccan 178; Harappa 174; Mehrgarh
 160; East and South-East Asia 204:
 Europe 93, 96, 98; England 377;
 Greece 346; Italy 350; LBK 359:
 South-West Asia 18, 96, 186, 189, 383,
 386; PPNB 139
 carbon isotopes 95
 free-threshing 158
 mutualism 393
- primitive 21
 wild 29, 106: Africa: Maghreb 285; Nile
 valley 293, 321: Central and South
 Asia: Indus valley 172; Turkmenistan
 158: Europe 352, 384: South-West
 Asia 109, 186: Natufian 122
 *see also under names of individual
 species*
- wheeled vehicles 391
 wheels 391
 whipworm 401, 401
 whistles 197
 White Bluff 232
 White Horse Stone 326, 371, 371
 White Nile 305
 White Ware 139
 white Yam 281
 white-faced monkey 241
 white-lipped peccary 52, 241
 white-tailed deer 239, 250, 258, 261,
 265
 Whittle, Alasdair 38
 Whuurong 70
 wickerwork weirs 62
 Wickham 232
 wigwams 251
 Wik Monkan 62
 wild
 foods 407
 progenitors 17, 18, 25, 30
 wildebeest 314
 wildscape 349, 376
 windbreaks 168
 Windmill Hill 326, 371, 372, 373,
 374
 sherds 378
 Windover 232, 243
 winnowing 61, 269
 wolves 379
 Wonio 70
 wood(en) 76, 87, 132, 188, 196
 arrow shafts 75
 bows 201
 containers 203
 handles 14
 landscape markers 343
 paddle, Star Carr 338
 platforms 367
 tools 203, 212, 295, 311
 -working tools 139
 Woodburn, James 49

- woodland
 Africa 306
 Americas 65, 237, 239, 260; *see also*
 North America, eastern
 Woodlands
 climate 27, 118
 deciduous 117
 Europe 352, 375
 pandanus 61
 soils 16
 South-West Asia 110, 128
 see also forest(s)
 wool 89, 145, 151
 woolly rhinoceros 4, 5
World Prehistory 24
 world-views 38, 53, 57–60, 89, 349, 368,
 406, 410, 412
 wormwoods 110
 Wu'an 194
 Wuyang county 194
- Xanthosoma sagittifolium* 234, 256,
 257
 xenophobia 383
 Xianrendong Cave 183, 187, 188, 190,
 195
 Xinle forager-farmers 200
 Xom Trai 183, 188
- Y-chromosome data 323
 Yafteh 114
 Yagi 183, 201
 yak 403
 yams
 domesticated 11, 31: Africa 281, 281,
 288: Americas 234, 257, 258, 269, 388:
 East and South-East Asia 185, 217,
 226, 387: New Guinea 220, 221, 221;
 Sarawak 224; Sumatra 64
 starch grains 85, 85, 259
 wild 86, 223: Africa 277, 311, 322:
 Americas 269: Australia 63, 75, 396:
 Central and South Asia 178: East and
 South-East Asia 84, 186, 207: Niah
 Cave 85
 Yamana 43
 Yanadis 151
 Yang-shao Neolithic culture 24, 183, 189,
 199, 200
 village 198, 198
 Yang-shaocun, *see* Yang-shao
- Yangtze, *see* Yangzi
 Yangzi 182, 183, 185, 187, 215
 delta 206
 farming communities 192
 valley 190, 191, 195, 198, 387
 Yarnton 377
 Yayoi period 204
 yellow foxtail millet 152
 Yellow river, *see* Huanghe river
 yellow yam 281
 Yellowstone region 246
 yoghurt 145, 303
 Yolngu 43
 Yombon 183
 Younger Dryas stadial 117, 117
 Americas 262
 East and South-East Asia 187, 188, 200,
 387
 Europe 332, 398
 South-West Asia 118, 128, 129, 130, 131,
 146, 384, 389
 Ystad 326, 365
 surveys 369
 Yucatan peninsula 257, 258
 yucca, *see* manioc
 Yuchanyan cave 183, 187
 Yukon 235
- Zagros mountains 104, 105
 climate 131
 einkorn 106
 foothills 28
 foraging 130–31
 game 109
 lithic industries 154, 162
 migration from 158, 385
 obsidian 142
 region 136, 137, 139, 194
 sheep and goats 146, 384
 woodland 105, 118
 Zarzian communities 114,
 125
 Zaire river 311
 valley 312
 Zambia 316
Zamia debilis 265
 Zaña 266
 valley 232, 263, 265
 Zarzi 105, 114, 125
 foragers 114–16
 Shanidar 130

- Zawi Chemi Shanidar 105,
 130
Zea 259
Zea mays 257, 264
Zea mays ssp. *parviglumis*
 254
Zealand 365
zebras 314, 393
zebu cattle 151
 Aligrama 175
 in art 304: bull, on seal 173;
 figurines 167, 176
cow 106
fodder 177
Ganga valley 170
Harappan 171
Mehrgarh 160, 161
 PPNB 164
Zengpiyan Cave 183, 190
Zhishanyan, tools 193
Zimbabwe 316, 317
zimbabwe enclosures 319
Ziziphus 178, 292
 fruits 290, 305
Ziziphus jujuba 160
Ziziphus spinica-christi 115
zoological
 diversity 383
 research 88
Zuni 232
 pueblo 246
Zygophyllum sp. 122